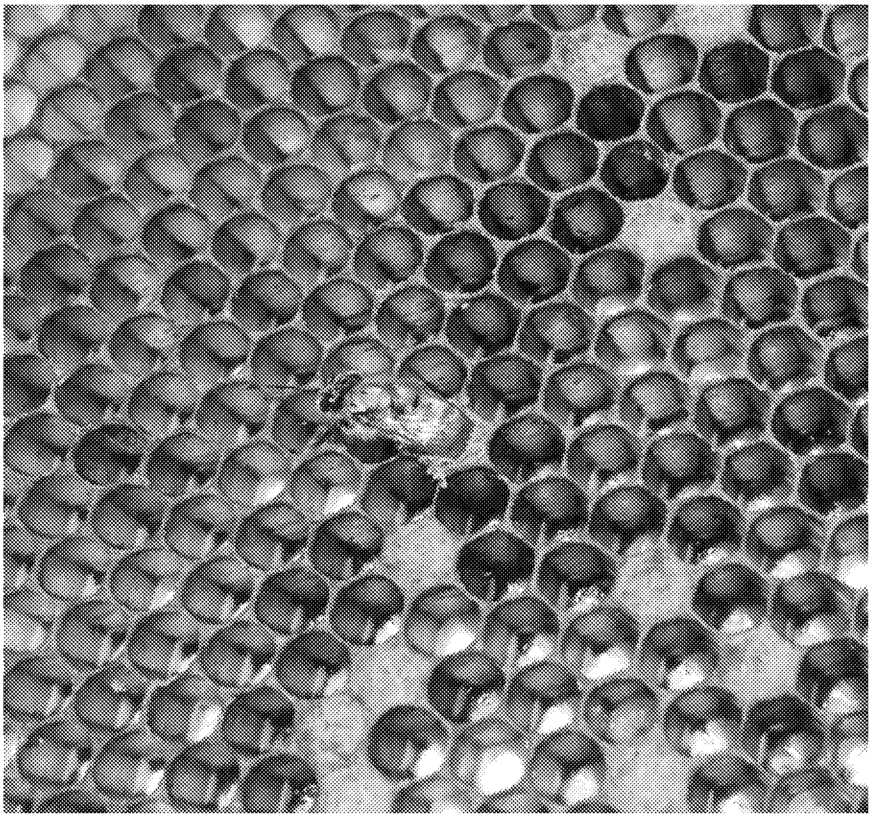
An addendum to this report has been issued and can be found at <https://www.cdpr.ca.gov/docs/registration/reevaluation/chemicals/addendum_neonicotinoid_risk_determination.pdf>

California Department of Pesticide Regulation

Pesticide Registration Branch

California Neonicotinoid Risk Determination



July 2018

Prepared by:

John Troiano, Ph.D., Research Scientist III
Brigitte Tafarella, Environmental Scientist
Alexander Kolosovich, Senior Environmental Scientist (Specialist)
Rochelle Cameron, Environmental Scientist
Denise Alder, Senior Environmental Scientist (Specialist)
Russell Darling, Senior Environmental Scientist (Specialist)

Approved by:

Marylou Verder-Carlos, DVM, MPVM., Assistant Director
Ann Prichard, Environmental Program Manager II
Margaret Reiff, Environmental Program Manager I

California Environmental Protection Agency
California Department of Pesticide Regulation
Pesticide Registration Branch
1001 I Street, P.O. Box 4015
Sacramento, California 95812

Contributors and Acknowledgments

DPR acknowledges the contributions and efforts of the following individuals and organizations:

Contributors

Richard Bireley (*former Senior Environmental Scientist (Specialist) with the California Department of Pesticide Regulation*), Senior Environmental Scientist (Specialist), California Department of Fish and Wildlife

Baktazh Azizi, Scientific Aid, California Department of Pesticide Regulation

Joseph Sullivan, Certified Wildlife Biologist, Ardea Consulting

Acknowledgments

The U.S. Environmental Protection Agency's Office of Pesticide Programs

Health Canada's Pest Management Regulatory Agency

On the cover: Photo of a bee on honeycomb. Photograph by DPR staff.

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1.0 Executive Summary

California leads the nation in cash farm receipts, and its agricultural production includes more than 400 commodities representing over a third of the country's vegetables and two-thirds of the country's fruits and nuts. Many of these agricultural commodities rely on pollination by bees for optimal production. Today, more than 2.5 million honey bee colonies in the United States pollinate an estimated $15 billion of crops each year, ranging from almonds to zucchini. Of these, approximately 1.8 million colonies are used in the pollination of California's almond crops alone.

Colony losses of these critical natural and managed pollinators have triggered worldwide concern in recent years. Multiple factors may contribute to colony losses and other risks to pollinator and hive health, including possible effects of neonicotinoid pesticides. This risk determination report, prepared by the Department of Pesticide Regulation (DPR) in response to California Food and Agriculture Code Section 12838, assesses those potential effects.

Neonicotinoid insecticides are systemic pesticides that kill insects by attacking their central nervous system. These insecticides are absorbed into plants and distributed throughout their tissues to their stems, leaves, roots, fruits and flowers. Neonicotinoids play an important role in the control of agricultural insect pests. Some examples include:

- Aphids that transmit citrus tristeza virus to citrus affecting the roots, leaves, and fruit causing a rapid decline in tree growth leading to death;
- The glassy-winged sharpshooter that transmits Pierce's disease to grapevines, a bacterium that blocks the movement of water within the plant, killing the vines within 1-3 years; and
- The Asian citrus psyllid that transmits huanglongbing disease to citrus trees causing a yellowing of tree shoots, asymmetrical and bitter fruit, and tree death in 5-8 years.

All of these diseases are known to spread rapidly and have the potential to cause massive destruction to the crops affected.

Neonicotinoids are insecticides developed as alternatives to organophosphates and carbamates that have a greater potential to affect human health (Cimino et al., 2017). Pesticide use reports received by DPR from the County Agricultural Commissioners across the state between 2007 and 2016 show that the use of neonicotinoids (imidacloprid, thiamethoxam, clothianidin, and dinotefuran) increased by 69.6%, while organophosphate and carbamate use decreased by 41.5% and 20.9%, respectively. California requires the monthly reporting of agricultural pesticide use to County Agricultural Commissioners, who in turn, report the data to DPR.

DPR was advised of the potentially harmful effects of neonicotinoids on pollinators in 2008. Studies of imidacloprid on ornamental plants revealed high levels of the insecticide in leaves and blossoms of treated plants, as well as increased imidacloprid residue levels in leaves and blossoms over time, indicating potential threats to pollinator health. In response to the disclosure, DPR placed pesticide products containing imidacloprid and the related neonicotinoid active ingredients thiamethoxam, clothianidin, and dinotefuran, into reevaluation on February 27, 2009 to assess the magnitude of their residues in the pollen and nectar of agricultural crops and the corresponding levels of risk to honey bee colonies. The reevaluation covered 50 registrants and 282 pesticide products with formulations or applications likely to move into plants that bloom or serve as a foraging source for honey bees and other pollinators (Appendix 1). In 2014, the Legislature adopted AB 1789 (Chapter 578, Statutes of 2014) requiring DPR to issue a determination with respect to its reevaluation of neonicotinoids by July 1, 2018, and adopt control measures necessary to protect pollinator health within two years after making the determination (Appendix 2).

This risk determination report documents the results of the DPR's neonicotinoid reevaluation and its first ecologically-based risk assessment. As part of this assessment, the department partnered with scientists at the U.S. Environmental Protection Agency's (U.S. EPA) Office of Pesticide Programs and the Health Canada Pest Management Regulatory Agency to develop the methods and procedures used to conduct ecologically-based studies on the effects of neonicotinoids. DPR followed the methods established by the group to assess the risks of exposure to bee colonies foraging on nectar and pollen in crops treated with the subject neonicotinoids, comparing the levels of neonicotinoid residues to concentrations that cause colony-level effects such as decreased colony strength and decreased stores of honey in honeycombs.

DPR based its risk determination on a series of studies that exposed bee colonies to four types of neonicotinoids (imidacloprid, thiamethoxam, clothianidin and dinotefuran) to establish residue levels in pollen and nectar that produced no observed effects on the colonies (No Observed Effect Concentrations, or NOECs). The department compared those NOEC values to residue levels found on selected agricultural crops in the field. DPR scientists then determined risk levels for combinations of specific crop groups and pesticide application methods (e.g., foliar [applied to leaves] or soil). Crop-application combinations with pollen or nectar residue levels that exceeded the NOEC values were determined to present a risk. Crop-application combinations with residue levels below the NOEC values were determined to be low risk. These risk determinations were based on the maximum allowed annual application rates in California for each agricultural crop group for each of the neonicotinoids listed above, and therefore represent "worst-case" scenarios (Appendix 3). Actual annual application rates may present less risk.

Crop groups considered to present a risk at maximum annual application levels of at least one of the neonicotinoids listed above include fruiting vegetables (e.g., cucumbers, tomatoes), berries, citrus, and tree nuts. Among the crop groups for which maximum application levels are considered a low risk are root and tuber vegetables (e.g., potatoes, turnips), bulb vegetables (e.g., onions, garlic), leafy vegetables and legumes. Again, these are conservative assessments based on maximum allowable application rates, and vary according to the neonicotinoid applied. Additional information on crop group risk may be found in Table 6.

Going forward, DPR will consider mitigation measures for neonicotinoid applications to crops characterized as at risk to reduce residues to levels below the respective NOEC. Such measures could include modifying application rates or the times at which applications may occur. This mitigation process will likely take two years to complete and will include continued research, consultation with experts, other stakeholders, and the use of technology designed to predict measures necessary to ensure bee colony health.

2.0 Background

On February 27, 2009, DPR placed certain pesticide products containing the neonicotinoid active ingredients, imidacloprid, thiamethoxam, clothianidin, and dinotefuran, into reevaluation (Appendix 1). DPR initiated the reevaluation based on submitted adverse effects disclosure data involving the active ingredient imidacloprid. DPR's Ecotoxicology unit evaluated the adverse effects data and noted high concentrations of imidacloprid in leaves and blossoms of treated ornamental plants, with an increase in measured concentrations over time. These observations of residues in treated plants led to a concern over potential exposure of honey bee colonies used for pollination services where hives are purposely placed around agricultural fields. Thiamethoxam, clothianidin, and dinotefuran are in the same chemical class as imidacloprid, known as the nitroguanidine-substituted neonicotinoid insecticides, and have similar physicochemical properties (e.g., soil mobility, half-lives, and toxicity to honey bees; Appendix 5). Thus, DPR included these active ingredients in the reevaluation. The purpose of this reevaluation is to provide DPR with a better understanding of the magnitude of neonicotinoid residues in pollen and nectar of agricultural commodities resulting from legal pesticide applications and the resulting level of risk to honey bee colonies. These data are necessary to provide a credible scientific basis for potential regulatory action to mitigate any significant adverse effects on honey bee health resulting from the use of neonicotinoid insecticides. DPR exempted from the reevaluation products formulated as a gel or impregnated in a strip, termiticides, flea control products combined with rodenticides, pet spot products, ant and roach baits, premise applications for control of nuisance pests, and manufacturing use only products because as formulated or applied, it is unlikely that the neonicotinoid in such products will move into plants that bloom or is a source of forage for honey bees and pollinators.

As part of the reevaluation, DPR required pesticide manufacturers to provide additional data that would allow DPR scientists to conduct a scientific determination of risk. DPR's reevaluation focused on gathering data on residue concentrations in the nectar and pollen of certain neonicotinoid-treated orchard and row crops. On September 15, 2009, DPR issued letters to the registrants of the four pesticide active ingredients describing the objectives and basic design of the studies to be conducted. Sampling was to be conducted in a minimum of three agricultural sites over two consecutive years. When possible, the agricultural sites were selected based on soil texture with three replicates in sandy, coarse-textured soils, three replicates in loamy, medium-textured soils, and three replicates in clayey, fine-textured soils. DPR used the Pesticide Use Reporting database to determine the crops of focus for each active ingredient (DPR, 2018b). On March 12, 2012, DPR modified its residue study strategy to require applications at the highest maximum annual application rate for two consecutive years.

DPR partnered with scientists at the U.S. Environmental Protection Agency's (U.S. EPA) Office of Pesticide Programs and Health Canada Pest Management Regulatory Agency (PMRA) to ensure that required data on the effects of neonicotinoids would provide useful and reliable information across the board for all three agencies to use in guiding their regulatory actions. On June 20, 2014, a Presidential Memorandum creating a federal strategy to promote the health of honey bees and other pollinators was signed. Subsequently, DPR, U.S. EPA, and PMRA published a collaborative document titled, *Guidance for Assessing Pesticide Risks to Bees*

(U.S. EPA, PMRA, and DPR, 2014), which established a tiered approach to data collection and risk assessment.

In January 2016, U.S. EPA, in collaboration with DPR, issued a preliminary pollinator risk assessment for imidacloprid. In January of 2017, U.S. EPA issued preliminary pollinator risk assessments for thiamethoxam, clothianidin, and dinotefuran. U.S. EPA's preliminary pollinator risk assessments include Tier I (acute toxicity) assessments based on model-generated estimates of exposure and laboratory toxicity data at the individual bee level, for all four active ingredients. The Tier I assessments indicate that there is potential risk to honey bees for all crops and application methods where there is a potential for on-field exposure (U.S. EPA and DPR, 2016; U.S. EPA, 2017a; U.S. EPA, 2017b). In accordance with the *Guidance for Assessing Pesticide Risks to Bees* (U.S. EPA, PMRA, and DPR, 2014), U.S. EPA conducted Tier II assessments for imidacloprid, thiamethoxam and clothianidin, and a Tier I assessment on dinotefuran using available data. Tier II assessments compare residue data to colony-level effects data.

A refined Tier II assessment is the focus of DPR's risk determination document. DPR's determination starts with U.S. EPA's preliminary pollinator assessments and includes new data submitted to DPR for all four active ingredients since the issuance of U.S. EPA's preliminary pollinator assessments. This risk determination document meets the requirements of FAC §12838 (a) which states, "On or before July 1, 2018, the department shall issue a determination with respect to its reevaluation of neonicotinoids" (Appendix 2).

3.0 <u>Scope</u>

3.1 Pesticide Type, Class, and Mode of Action

Neonicotinoid insecticides are systemic pesticides that target nicotinic acetylcholine receptors in the central nervous system of insects. DPR's neonicotinoid reevaluation focuses on the nitroguanidine-substituted neonicotinoids (imidacloprid, clothianidin, thiamethoxam, and dinotefuran) as all four active ingredients share similar physicochemical characteristics and toxicity to honey bees. Neonicotinoids are systemic compounds and readily move through the vascular system, xylem and phloem, of plants which then translocate into various plant tissues. Neonicotinoids can be applied using several different application methods including foliar application by aerial or ground spray equipment, soil drench, chemigation, or seed treatment (U.S. EPA and DPR, 2016; U.S. EPA, 2017a; U.S. EPA, 2017b).

3.2 Use Characterization

DPR first registered a pesticide product containing imidacloprid for sale and use in the State of California in 1994. Approximately ten years later, DPR registered the first pesticide products containing dinotefuran, clothianidin, and thiamethoxam (DPR, 2018a). Neonicotinoids are widely used pesticides with a variety of uses ranging from agricultural and residential insecticides, pet products, termiticides, ant and roach baits, and premise application products for nuisance pests. Neonicotinoids are currently registered for use on a diverse array of crops in California such as, but not limited to: citrus fruits, oilseed crops (e.g., cotton), cucurbit vegetables, fruiting vegetables, pome fruits, stone fruits, cereal grains, tree nuts, *Brassica* (Cole) leafy vegetables, root and tuber vegetables, leafy vegetables, legume vegetables, and bulb vegetables. For more information on registered agricultural use sites and specific application rates for each of the neonicotinoid active ingredients, refer to Appendix 3.

Neonicotinoids were developed as alternatives to organophosphates and carbamates (Cimino et al., 2017). Neonicotinoids play an important role in the integrated control of agricultural insect pests such as: aphids that transmit citrus tristeza virus to citrus; the glassy-winged sharpshooter that transmits Pierce's disease to grapevines; and the Asian citrus psyllid that transmits huanglongbing disease to citrus trees.

Pesticide use reports (PUR) between 2007 and 2016 indicate that use of neonicotinoids (imidacloprid, thiamethoxam, clothianidin, and dinotefuran) increased by 69.6% (131,168 lbs. neonicotinoid active ingredients used in 2007; 431,132 lbs. neonicotinoid active ingredients used in 2016) while organophosphate and carbamate use decreased by 41.5% (3,775,011 lbs. organophosphate active ingredients (listed below) used in 2007; 2,209,448 lbs. active ingredients used in 2016) and 20.9% (666,035 lbs. carbamate active ingredients (listed below) used in 2007; 526,677 lbs. active ingredients used in 2016), respectively. In 2016, organophosphates were frequently applied to oranges, almonds, walnuts, lettuce, and cotton while carbamates were frequently applied to oranges, corn, lettuce, tomatoes, and alfalfa. The most frequent neonicotinoid use sites in 2016 include grapes, tomatoes, oranges, tangerines, and pistachios. The inquiry into the PUR database for the organophosphate chemical group included the active ingredients acephate, bensulide, chlorpyrifos, diazinon, DDVP, dimethoate, fosthiazate malathion, ethoprop, naled, phorate, phosmet, tetrachlorvinphos, tribufos, disulfoton, ethoprop, fenamiphos, methamidophos, methidathion, oxydemeton-methyl, and profenofos while the carbamate group included the active ingredients formetanate HCI, methiocarb, methomyl, oxamyl, propoxur, thiodicarb, aldicarb, carbofuran, and carbaryl. Other chemicals that belong within the organophosphate and carbamate chemical group are not currently registered in the State of California.

3.3 Environmental Fate and Transport

Since neonicotinoids are systemic insecticides, they are transported through the vascular system of plants to all tissues, including leaves, nectar and pollen. Both foliar and soil applications of neonicotinoids have resulted in detectable residues in both nectar and pollen following absorption by the foliage, roots, or stems of plants (U.S. EPA and DPR, 2016; U.S. EPA, 2017a; U.S. EPA, 2017b). Physicochemical characteristics consistent among the four neonicotinoid active ingredients include a low organic carbon normalized soil adsorption coefficient (K_{oc}) value, low volatility, longevity in soil after application, and relatively high water solubility (Appendix 5). These properties contribute to the pesticides being highly available for uptake by plant roots. Moreover, neonicotinoids have two main routes of degradation through aquatic photolysis and aerobic soil metabolism (U.S. EPA and DPR, 2016; U.S. EPA, 2017a; U.S. EPA, 2017b). Degradation produces a variety of breakdown products known as metabolites. Refer to Appendix 5 for the specific physicochemical properties and environmental fate of each active ingredient.

This risk determination document includes measurements of metabolite concentrations identified as having similar or greater toxicity to honey bees than the parent compound. For imidacloprid, the evaluation includes the parent and two metabolites, imidacloprid-olefin (IMI-olefin) and imidacloprid-5-hydroxy (5-OH-IMI), since all three compounds have a similar toxicity to honey bees (U.S. EPA and DPR, 2016). Other metabolites do not have a similar toxicity (e.g. 6-chloronicotinic acid, 6-chloro-picolylalcohol, nitrosamine and urea). The risk determination will refer to total imidacloprid, which is the summation of residues of the parent imidacloprid, and the metabolites IMI-olefin and 5-OH-IMI.

The metabolite of concern for thiamethoxam is CGA-322704 (i.e., clothianidin), which itself is an active ingredient in registered pesticide products. As both compounds are toxic to honey bees (U.S. EPA, 2017b), concentrations of total residues for parent (thiamethoxam) and CGA-322704 will be reported and assessed. For clothianidin, the metabolites, N-(2-chloro-5-thiazolylmethyl)-N'-methylurea (TZMU) and N-(2-chloro-5-thizolylmethyl)-N'-nitroguanidine (TZNG) are routinely measured in the plant residue studies. Based on acute toxicity data, TZMU and TZNG are orders of magnitude less toxic to honey bees than the parent clothianidin (U.S. EPA, 2017b). As a result, DPR did not include these metabolites in the risk determination and all references to clothianidin refer to the parent molecule alone.

Dinotefuran metabolites measured in plant tissues include 1-methyl-2-nitro-3-(tetrahydro-3-furylmethyl) guanidine (UF) and 1-methyl-3-(tetrahydro-3-furylmethyl) guanidinium dihydrogen phosphate (DN). Toxicity data submitted to DPR indicate the UF and DN metabolites are less toxic to honeybees, so those metabolites are not included in DPR's risk determination and all references to dinotefuran refer to the parent molecule alone (U.S. EPA, 2017a).

3.4 Potential for Effects on Pollination Activity

This risk determination focuses on potential effects of neonicotinoid exposure on honey bees (*Apis mellifera*) after feeding on nectar and pollen containing neonicotinoid residues. Honey bees are purposefully situated around agricultural sites during bloom to pollinate various crops. As a result, foraging bees could be exposed to residues of these four neonicotinoids from applications made prior to bloom, during flowering, or post-bloom if the residues in bee-attractive matrices (e.g., pollen and nectar) persist for a sufficient duration. DPR's reevaluation required that plant residue studies be conducted using worst-case application scenarios (e.g., maximum application rates, minimum reapplication intervals) found on currently registered pesticide labels. These scenarios generally result in the highest realistic concentrations in the bee-attractive matrices. *Apis* bees serve as a surrogate for other non-*Apis* species of bees (e.g., bumble bees) that may be exposed under agricultural conditions. This surrogate approach is consistent with the *Guidance for Assessing Pesticide Risks to Bees* (U.S. EPA, PMRA, and CDPR, 2014). As described in the guidance document, the husbandry, life cycles, and contribution of pollinator services of honey bees are well-studied.

3.5 Colony Level Exposure and Effects

DPR evaluated both registrant-submitted and open literature (i.e., peer-reviewed research studies published in scientific journals) Tier II semi-field studies for this risk determination. The purpose of Tier II studies is to evaluate possible colony-level effects on hive health through foraging on nectar and pollen. DPR quantitatively evaluated oral consumption (e.g., consumption of contaminated nectar and pollen) as the primary exposure route for honey bees in this determination. In Tier II studies denoted as colony feeding studies, honey bee colonies are exposed to known concentrations of a compound in either surrogate nectar or pollen and measurements are taken that reflect the health of hives. Based on the observed responses from the colony feeding studies, No Observed Effects Concentrations (NOECs) are derived for each active ingredient. In this determination, DPR used the NOEC values to determine each active ingredient's potential to cause effects on hive health. The submitted colony feeding studies measured several response variables including colony survival, the number of cells containing various brood stages (eggs/larvae/pupae), the total population of adult bees per hive, and the number of cells containing food stores (pollen and nectar). Overall, the purpose of these studies is to determine the concentration of each neonicotinoid that honey bees can safely consume over a six-week period with no significant adverse colony-level effects. NOEC values were established for each of the four neonicotinoids in each of the two bee-attractive matrices (pollen and nectar; Table 1 below). DPR scientists compared these values to neonicotinoid concentrations in nectar and pollen collected from representative crops after worst-case scenario applications. DPR also evaluated and considered adverse effects data submitted pursuant to California Food and Agricultural Code (FAC) section 12825.5. However, those data did not provide information pertinent to the scope of this risk determination.

4.0 Risk Characterization Methodology

4.1 Overview of Risk Determination Process

The risk determination process generally follows the methods of a Tier II assessment as detailed in the *Guidance for Assessing Pesticide Risks to Bees* (U.S. EPA, PMRA, and CDPR, 2014). In accordance with the tiered risk assessment process, risks to bees were determined by comparing available exposure data to colony-level effects data. According to Tier I laboratory data, nitroguanidine-substituted neonicotinoids are acutely toxic to individual bees through both contact and oral exposure (Appendix 6). Contact exposure may occur through dermal uptake of residues on plant surfaces or by direct spray deposition onto bees. Oral exposure mainly occurs through the ingestion of contaminated pollen or nectar. Applications can be timed to avoid contact by spray deposition. However, risks to honey bees from oral exposure are more complex to regulate. Upon translocation of the systemic nitroguanidine-substituted neonicotinoids inside plant tissues, concentrations in pollen and nectar may persist, resulting in risks from oral consumption and/or transfer of residues back to the hives.

This risk determination focuses on potential effects posed by oral consumption, so exposure data were determined from measured residue concentrations of nitroguanidine-substituted neonicotinoids and their bee-toxic metabolites in the nectar and pollen of agricultural crops following worst-case scenario applications in compliance with product labels. The exposure data were compared to effects data generated from exposure of honey bee colonies to nectar or pollen spiked with known concentrations of imidacloprid, thiamethoxam, clothianidin, or dinotefuran with various colony-level parameters measured over time. The Tier II data discussed in this risk determination builds upon the preliminary pollinator risk assessments published by the U.S. EPA

(U.S. EPA and DPR, 2016; U.S. EPA, 2017a; U.S. EPA, 2017b) for the four neonicotinoid active ingredients while also incorporating additional California-specific data.

DPR scientists made risk determinations for specific crop groups and application method combinations (e.g., foliar, soil), and characterized them as either having a determination of risk or low risk to honey bee colonies. A determination of risk resulted when residue concentrations in nectar or pollen exceeded the colony-level NOEC for that matrix (e.g., pollen or nectar). Conversely, a determination of low risk resulted when residue concentrations in pollen or nectar did not exceed the respective colony-level effects concentration (e.g., the concentrations were low enough that they would not result in any significant adverse effects to honey bee colonies). The risk determinations are based on oral exposure (e.g., the consumption of contaminated nectar and pollen). Methods used to generate the effects data and exposure data and their utilization in the risk determinations are described in Section 4.2.

Risk determinations were only conducted for foliar and soil applications. Risks from seed treatment applications were evaluated in the preliminary pollinator risk assessments published by U.S. EPA (U.S. EPA and DPR, 2016; U.S. EPA, 2017a; U.S. EPA, 2017b). The preliminary assessment for imidacloprid evaluated multiple seed treatment residue studies conducted on corn, canola, and sunflower. These studies generally reported no residues in pollen and nectar above the limit of detection. Values are well below their respective NOEC values, supporting the conclusion that imidacloprid seed treatments pose a low risk to honey bees. The preliminary pollinator risk assessment for clothianidin and thiamethoxam evaluated multiple seed treatment residue studies conducted on corn, sunflower, melon, canola, cotton, and soybean. The resulting residue concentrations are all below the respective NOECs, supporting the conclusion that clothianidin or thiamethoxam seed treatments pose a low risk to honey bee colonies. Dinotefuran is not registered for any seed treatment applications. There have been issues in other states and countries with contact exposure resulting from abraded seed coat dust at planting, but the U.S. EPA has addressed this with best management practices (U.S. EPA and DPR, 2016). DPR has no records of such incidents occurring in California.

4.2 Effects Characterization

Potential effects on honey bees were determined from Tier II studies, which assess effects of exposure at the colony level. The complex nature of assessing hive dynamics and colony-level effects necessitated multiagency collaboration to develop protocols that maximized the regulatory usefulness of such studies. Accordingly, study protocols were developed collaboratively through the efforts of DPR, U.S. EPA, and PMRA scientists, and in consultation with industry experts. This cooperative effort aimed at ensuring reproducibility of results and maximizing statistical power to detect effects while minimizing uncertainties and potential confounding factors, such as diseases, pests, or poor nutrition, which have each been independently associated with declines in colony health.

In comparison to Tier I laboratory studies, which focus on individual bees, Tier II studies focus on colony-level effects and assess a longer period of exposure under conditions that are more representative of exposure in the field. These include semi-field studies such as tunnel studies and colony feeding studies. Tunnel studies typically involve enclosing small bee colonies within a confined area of treated crops on which bees forage. In colony feeding studies, unconfined colonies are provided a food source, such as sucrose solution or pollen patties, that has been spiked with a known and measured concentration of a specific pesticide. Multiple concentrations are tested to produce a dose-response relationship between the concentrations tested and the observed health of the hives. In colony feeding studies, bees are generally exposed to the test feeding substances for six weeks. Measurements of hive health (i.e., Colony Condition Assessments) are taken at multiple time points prior to, during, and after the exposure period. Additionally, an overwintering component is typically included, with at least one additional assessment after the overwintering period. Hive health is determined by measuring parameters such as the population of adult bees (i.e., colony strength), the number of cells containing various brood stages (eggs, larvae, and pupae), and measuring hive resources in terms of honey and bee bread production (U.S. EPA, PMRA, and CDPR, 2014).

The Tier II studies considered in this risk determination document were subject to thorough evaluation for scientific acceptability. As part of this evaluation, DPR, U.S. EPA, and PMRA scientists assessed registrant-submitted study protocols prior to study initiation to ensure that the study designs were scientifically sound. Some examples of the types of requirements necessary for a study design to be deemed scientifically sound include adequate replication and confirmation of exposure by repeated sampling and analysis of spiked sugar solutions or spiked pollen patties to ensure that the honey bee colonies are actually exposed to the neonicotinoid concentrations as planned. Many of the open literature studies reviewed by DPR scientists (Appendix 7) lacked this level of replication and confirmation of exposure. In some cases, study authors were reluctant to provide DPR statisticians with the raw data needed to conduct independent statistical analyses. All colony-level NOEC values used in this assessment are based on mean measured concentrations that resulted from analyses conducted in compliance with rigorous analytical quality control procedures. For scientifically acceptable studies, DPR, U.S. EPA, and PMRA statisticians conducted independent statistical analysis of raw data on pertinent endpoints. In its risk determination process, DPR used the measured concentrations in the sugar solutions or spiked pollen patties associated with these regulatory endpoints. This results in a level of accuracy and certainty that cannot be achieved using nominal concentrations that were never confirmed analytically.

Although DPR considered both open literature and registrant-submitted studies, the registrant-submitted studies were generally found to be more robust and comprehensive when characterizing colony-level effects. These studies had greater replication and confirmation of exposure, and the raw data were available for independent statistical analysis. DPR, U.S. EPA, and PMRA statisticians and biologists independently determined the NOEC values for each active ingredient from studies found to be scientifically acceptable. Refer to Table 1 below for the NOEC concentrations determined for each active ingredient and matrix (i.e., nectar and pollen) combination (e.g. thiamethoxam in nectar). Utilizing only scientifically acceptable studies in the risk determination process produced data gaps in colony-level effects data for pollen. Specifically, acceptable pollen colony feeding studies were not available for thiamethoxam or dinotefuran, necessitating the use of another neonicotinoid as a surrogate. Accordingly, the NOEC value for clothianidin in pollen was bridged to thiamethoxam and dinotefuran. DPR found an acceptable colony feeding study conducted with pollen spiked with imidacloprid in the open literature (Dively et al., 2015). For a review of all the colony feeding studies included in this document, refer to Appendix 8.

As indicated in Table 1, NOEC values are lower for nectar than for pollen. These differences may be explained by the nature of these resources and how they are utilized within the hive. The movement of nectar around the hive is rapid and has been described as a cascade effect where it ultimately encounters most of the hive occupants and matrices. In addition, nectar is added to pollen by hive bees to produce bee bread. In contrast, bees foraging for pollen bring the pollen into the hive and pack it directly into pollen cells themselves. Bees consume less pollen than nectar, based on estimated food consumption rates for honey bees (U.S. EPA, PMRA, and CDPR, 2014). The highest consumption rate of pollen is found in new worker bees that clean and cap cells within the hive. These bees consume only 1.3 – 12 mg/day of pollen compared to approximately 60 mg/day of nectar. After 10 days, the new worker bees move to brood and queen tending. During brood and queen tending, worker consumption of pollen remains the same, whereas, nectar consumption more than doubles to 113 – 167 mg/day (U.S. EPA, PMRA, and CDPR, 2014). All other adult bees consume less pollen per day than nectar. This tendency for immediate exposure of residues in nectar brought back to hives, and the more limited exposure to pollen within the hive, suggests that concentrations of a toxic substance in pollen must be higher than concentrations in nectar to elicit a colony-level effect.

Table 1. Pollen and Nectar NOECs used in the Risk Determinations for Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran.

Active Ingredient	NOEC (µg/Kg)
Nectar – Colony Feeding Studies	
Imidacloprid [a]	23
Thiamethoxam [b]	30
Clothianidin [c]	19
Dinotefuran [d]	71
Pollen – Colony Feeding Studies	
Imidacloprid [e]	97.5
Thiamethoxam [f]	372
Clothianidin [g]	372
Dinotefuran [f]	372

All toxicity values derived from the following colony feeding studies:

[a] Bocksch, 2014.

[b] Bocksch, 2015.

[c] Louque, 2016.

[d] Bocksch, 2016.

[e] Dively et al., 2015.

[f] Bridged from the registrant-submitted colony feeding study with clothianidin.

[g] Bocksch and Werner, 2018.

4.3 Exposure Characterization

To determine the expected on-field exposure, measurements of imidacloprid, thiamethoxam, clothianidin, and dinotefuran were taken in pollen and nectar from previously treated crops. Data were generated for the worst-case scenarios (i.e., highest annual application rates, minimum reapplication intervals, etc.) in compliance with product label directions to provide an estimate of the highest concentrations expected for each active ingredient in nectar and pollen of agricultural crops. The plants were treated under standard agricultural practices (e.g. foliar applications, soil applications, or seed treatments along with irrigation, use of fertilizers, other maintenance chemicals, etc.) as indicated on product labels for crops under investigation. Nectar and pollen samples were not available for all crops. For example, tomato flowers do not produce nectar. In such instances, only pollen samples were available for inclusion in the risk determination. Another exception can be seen with cotton, which produces extra-floral nectar in addition to floral nectar. Cotton extra-floral nectar is known to be a highly attractive resource of forage for honey bees and some beekeepers place their hives near cotton for honey production (McGregor, 1976; USDA, 2017). Accordingly, extra-floral nectar was included in this risk determination for applications to cotton crops. In the rare cases where floral pollen samples were not available for analysis, measured residue concentrations in anthers served as a surrogate.

Statistical analyses were conducted on measured neonicotinoid concentrations in bee-relevant matrices (e.g., pollen and nectar) for each acceptable residue study. DPR did not conduct statistical analysis on seed treatment residue studies, as concentrations were always low, and often below analytically detectable limits. Statistical analysis included the generation of the cumulative empirical distributions of measured concentrations. The cumulative distributions calculate a series of percentile values representing the proportion of samples that are below that value. For estimation of exposure, the concentration chosen at a specified percentage of the sample is the value that represents the exposure value that would be compared to the NOEC value derived from colony feeding studies to characterize potential risk.

For the risk determination, DPR scientists took many factors into consideration when determining which percentile value to use for protection of honey bee colonies. Use of moderate statistics, such as the mean or median, would not reflect the possible danger posed at the higher end of measured distributions, and therefore, would not be protective for two reasons: First, considering the extent of agricultural applications made for each crop in California, the amount of data collected is relatively small compared to the total population (e.g., 27 samples of nectar collected from pumpkins might not be representative of all pumpkins grown in California). Thus, the range in actual concentrations could be much greater and extreme residue values that appear to be statistical outliers might not actually be outliers if more samples were available. Many of the studies used in this risk determination have less than twenty total samples, even when all data were combined from studies spanning two years. Second, concentrations measured in nectar in some of the studies were high enough to be of concern for acute toxicity to honey bees. Use of moderate statistics such as the mean concentration would not reflect the risks from these extreme exposures.

On the other hand, use of maximum measured values in the risk determination could be overly protective because they include outliers. Many samples taken for estimation of exposure represented only one point in time, so it is unknown if the concentrations in pollen and nectar were increasing or decreasing. Since these measured concentrations only provide a snapshot of exposure, direct comparison of colony level NOEC values to maximum values measured in the pollen or nectar samples has a high degree of uncertainty because the duration of exposure to concentrations that exceed the NOEC might be significantly shorter than the six-week duration of the colony feeding studies. This would vary for each crop and would depend on the duration of bloom. Based on the uncertainty associated with the duration of exposure, use of higher percentiles could be unrealistic. Consequently, the 90^{th} percentile value was determined to be a point in the distribution where the value represented a realistic, yet protective approach to determining risk.

DPR based this risk determination document on numerous residue studies submitted by the registrants of neonicotinoid insecticide products. Descriptions of methods, results, and limitations of these studies are available in Appendix 10. In addition, the cumulative empirical distributions of measured concentrations for each residue study included in this document are presented in Appendix 11. In many cases, residue data was only available for one or two crops within a specific crop group [as defined in Title 40 Code of Federal Regulations (40 CFR) § 180.41; Appendix 4]. In cases where residue data was lacking for a specific crop, the worst-case scenario within the same crop group was used to represent the missing crop. Additionally, there were cases in which there was no residue data available for an entire crop group. In such instances, data from an appropriate surrogate was used, such as the same crop group from a study utilizing a different nitroguanidine-substituted neonicotinoid active ingredient. In its reevaluation letter, DPR notified registrants of its intention to bridge data from one active ingredient to any of the other three active ingredients if no residue data were available for a given crop or crop group (Appendix 12).

4.4 Risk Determination Categories

DPR conducted risk determinations for agricultural uses registered in California with expected worst-case on-field exposure to honey bees. Applications of neonicotinoid insecticides may result in on-field exposure to honey bees when the crop is bee-attractive and harvested after bloom. Crop groups with limited on-field exposure to honey bees are considered low-risk. According to the United States Department of Agriculture document, *Attractiveness of Agricultural Crops to Pollinating Bees for the Collection of Nectar and/or Pollen* (USDA, 2017), certain crops and crop groups, such as bulb vegetables, leafy vegetables (including *Brassica* vegetables), and globe artichokes, are generally harvested before bloom, except when grown for seed. Thus, the risk determinations for these crops and crop groups are classified as low risk, except when grown for seed.

For crops associated with expected on-field exposure to honey bees, the 90th percentile was calculated using residue data conducted at the maximum annual application rate and compared to colony-level NOEC values to determine risk. Risk determinations were categorized as either having a determination of risk, or low risk to honey bee colonies. Determinations of risk were made for those crops or crop groups with 90th percentile pollen or nectar residue values that exceed the appropriate NOEC value for the specific active ingredient and matrix. Conversely, low risk determinations are those crops or crop groups with 90th percentile pollen or nectar residue values that do not exceed the appropriate NOEC value. For more details, including exceptions, refer to Tables 2-5.

It is important to note that determinations of risk in Table 6 were derived from worst-case application scenarios. Crops with determinations of risk may be able to be mitigated by modifying label use directions in a manner that will result in residues that are below the respective NOEC values. By definition, if the residues in pollen or nectar are below the respective colony-level NOEC values, then no significant colony effects are expected to occur. The footnotes in Table 6 provide guidance on some potential adjustments to management practices and label directions based on submitted data that could result in a determination of low risks to honey bee colonies.

5.0 Risk Characterization

DPR made risk determinations for specific crops where crop-specific data was available (Tables 2, 3, 4, and 5 below). In most cases, residue data were only available for one or two crops within a specific crop group. In cases where there were no residue data for other crops in the group, the worst-case scenario (i.e., specific crop data that resulted in the highest residues in pollen and nectar) within the same crop group was used to represent all other crops in that crop group. For example, for imidacloprid, the Berries Crop Group (Crop Group 13) includes both a strawberry and blueberry residue study (Table 2). The strawberry study resulted in higher residues than the blueberry study. Thus, DPR used the risk determination based on the strawberry residue data to represent all crops within Crop Group 13, with the exception of blueberries. The submission of additional data can change these determinations on a crop by crop basis.

Similarly, if a given crop and active ingredient had more than one acceptable residue study, the study that resulted in the higher residues was used to represent that crop in the final risk determination for that crop. One case in which this occurred was with thiamethoxam and cucumber. There are two acceptable cucumber residue studies. DPR used the study with the highest residues in pollen and nectar to represent cucumbers in the overall risk determination. This conservative approach is appropriate given the limitations of the residue data in terms of relatively small sample sizes, environmental variability, and the various other factors (e.g., soil texture, irrigation practices, use of fertilizers, temperature, etc.) that can influence how representative these data sets are of the crops grown in various microclimates of California. If no acceptable residue data was available for a crop group, data from an appropriate surrogate was used, such as data on the same crop group using a different nitroguanidine-substituted neonicotinoid active ingredient.

Tables 2, 3, 4, and 5 below, show which crops had available residue data at the maximum application rate. These tables compare the resulting residue concentrations to appropriate NOEC values, state if the residues exceed the respective NOEC values, and make determinations of risk based on 90th percentile residue values:

Table 2. Imidacloprid 90th percentile residue values and NOEC exceedances.

Imidacloprid								
Crop Group	Crop	Residue Study Lab ID	Application	Residue Matrix	Residue (µg/Kg)	NOEC (µg/Kg)	Exceedance (Y/N)	Risk
Crop Group 8. Fruiting Vegetables Group	Tomato	EBNTN012	1 Soil + 2 Foliar	Pollen	476.9	97.5	Y	
Crop Group 10. Citrus Fruit Group	Orange	EBNTY007	2 Foliar (Pre-Bloom)	Pollen	3257.9	97.5	Y	
				Nectar	267.1	23	Y	
	Citrus [a]	EBNTL056-7	1 Soil	Nectar	25.0	23	Y	
Crop Group 11. Pome Fruits Group	Apple	EBNTN014	1 Soil + 2 Foliar	Pollen	58.5	97.5	N	
				Nectar	3.5	23	N	
Crop Group 12. Stone Fruits Group	Stone Fruit [b]	EBNTN013	1 Soil + 2 Foliar	Pollen	136.2	97.5	Y	
				Nectar	9.5	23	N	
	Cherry	EBNTY008	5 Foliar	Pollen	393.8	97.5	Y	
				Nectar	5.1	23	N	
Crop Group 13. Berries Group	Blueberry	EBNTY006	1 Soil	Pollen	17.5	97.5	N	
				Nectar	4.6	23	N	
	Strawberry	EBNTL056-04	1 Soil	Pollen	247.0	97.5	Y	
Crop Group 20. Oilseed Group	Cotton	EBNTN011	1 Soil + 3 Foliar (At Bloom)	Pollen	182.2	97.5	Y	
				Floral Nectar	107.0	23	Y	
				Extrafloral Nectar	578.6	23	Y	
		EBNTY010	5 Foliar (Pre-Bloom)	Pollen	6.6	97.5	N	
				Floral Nectar	18.4	23	N	
				Extrafloral Nectar	13.3	23	N	

Notes:

Red shading indicates soil or foliar applications that result in pollen or nectar residues that exceed the NOEC.

Green shading indicates soil or foliar applications that do not result in pollen or nectar residues that exceed the NOEC.

[a] Residue study was conducted on multiple crops within the crop group, including orange, tangerine, grapefruit, tangelo, and lemon. However, data was not analyzed by individual crop due to limited replication.

[b] Residue study was conducted on multiple crops within the crop group, including cherry, plum, apricot, and peach. However, data was not analyzed by individual crop due to limited replication.

Table 3. Thiamethoxam 90th percentile residue values and NOEC exceedances.

Thiamethoxam								
Crop Group	Crop	Residue Study Lab ID	Application	Residue Matrix	Residue (µg/Kg)	NOEC (µg/Kg)	Exceedance (Y/N)	Risk
Crop Group 6. Legume Vegetables (Succulent or Dried) Group	Soybean	TK0250070	2 Foliar	Anthers	41.2	372	N	
				Nectar	4.7	30	N	
Crop Group 8. Fruiting Vegetables Group	Tomato	TK0222531	2 Foliar	Pollen	6519.7	372	Y	
		TK0242072	1 Soil	Pollen	157.2	372	N	
	Pepper	TK0236306	1 Soil	Pollen	259.9	372	N	
				Nectar	180.9	30	Y	
Crop Group 9. Cucurbit Vegetables Group	Cucumber	TK0024668	1 Soil	Pollen	10.8	372	N	
				Nectar	13.2	30	N	
		TK0222532	2 Foliar	Pollen	1079.9	372	Y	
				Nectar	288.6	30	Y	
	Muskmelon	TK0222530	1 Soil	Pollen	119.7	372	N	
				Nectar	27.9	30	N	
	Pumpkin	TK0222530	1 Soil	Pollen	8.1	372	N	
				Nectar	12.2	30	N	
		TK0242074	2 Foliar	Pollen	18.0	372	N	
				Nectar	15.0	30	N	
	Summer Squash	TK0222530	1 Soil	Pollen	16.1	372	N	
				Nectar	31.7	30	Y	
Crop Group 10. Citrus Fruit Group	Citrus [a]	TK0177221	1 Soil	Pollen	62.3	372	N	
				Nectar	10.2	30	N	
	Sweet Orange	TK0250069	2 Foliar	Pollen	126.7	372	N	
				Nectar	2.1	30	N	
Crop Group 11. Pome Fruits Group	Apple [b]	TK0250071	1 Foliar	Pollen	1954.7	372	Y	
				Nectar	225.4	30	Y	
Crop Group 12. Stone Fruits Group	Stone Fruit [c]	TK0177222	2 Foliar	Pollen	1.6	372	N	
				Nectar	133.2	30	Y	
Crop Group 13. Berries Group	Blueberry	TK0250072	3 Foliar	Pollen	836.4	372	Y	
				Nectar	613.0	30	Y	
	Strawberry	TK0177224	3 Foliar	Pollen	7411.0	372	Y	
				Nectar	301.0	30	Y	
		TK0250068	1 Soil	Pollen	541.0	372	Y	
				Nectar	52.3	30	Y	
	Cranberry	TK0236307	3 Foliar	Pollen	1226.4	372	Y	
				Nectar	921.9	30	Y	
Crop Group 15. Cereal Grains Group	Corn	TK0258214	Seed + 2 Foliar	Pollen	538.9	372	Y	
Crop Group 20. Oilseed Group	Cotton	TK0177223	2 Foliar	Pollen	102.5	372	N	
				Nectar	5.8	30	N	
				Extrafloral Nectar	125.9	30	Y	

Notes:

Red shading indicates soil or foliar applications that result in pollen or nectar residues that exceed the NOEC.

Green shading indicates soil or foliar applications that do not result in pollen or nectar residues that exceed the NOEC.

[a] Residue study was conducted on multiple crops within the crop group, including orange and lemon. However, data was not analyzed by individual crop due to limited replication.

[b] The residue study for this crop was not conducted at the maximum application rate allowed by the product label, therefore worst-case residues are expected to be higher than reported in this table.

[c] Residue study was conducted on multiple crops within the crop group, including peach, plum, cherry, and prune. However, data was not analyzed by individual crop due to limited replication.

Table 4. Clothianidin 90th percentile residue values and NOEC exceedances.

Clothianidin								
Crop Group	**Crop**	**Residue Study Lab ID**	**Application**	**Residue Matrix**	**Residue (µg/Kg)**	**NOEC (µg/Kg)**	**Exceedance (Y/N)**	**Risk**
Crop Group 1. Root and Tuber Vegetables Group	Potato	VP-38985	1 Soil	Pollen	113.9	372	N	
Crop Group 9. Cucurbit Vegetables Group	Cucumber	VP-38938	1 Soil	Anthers	32	372	N	
				Nectar	39.6	19	Y	
	Melon	VP-38938	1 Soil	Anthers	18.7	372	N	
				Nectar	14.6	19	N	
	Squash	VP-38938	1 Soil	Pollen	10.7	372	N	
				Nectar	4.4	19	N	
	Pumpkin	VP-38938	1 Soil	Pollen	21	372	N	
				Nectar	6.6	19	N	
		VP-38263	1 Soil (At Planting)	Pollen	17	372	N	
				Nectar	6.3	19	N	
		VP-38313	2 Foliar	Pollen	71	372	N	
				Nectar	5	19	N	
		VP-38971	1 Soil (Post-Emergence)	Pollen	20.3	372	N	
				Nectar	9.9	19	N	
Crop Group 11. Pome Fruits Group	Apple [a]	VP-38552	1 Foliar (Post-Bloom)	Pollen	57.4	372	N	
				Nectar	0.71	19	N	
Crop Group 12. Stone Fruits Group	Peach [a]	VP-38563	2 Foliar (Post-Bloom)	Pollen	10	372	N	
				Nectar	0.3	19	N	
Crop Group 13. Berries Group	Grape	VP-38992	1 Soil	Pollen	157.3	372	N	
			1 Foliar (Pre-Bloom)	Pollen	1229.8	372	Y	
Crop Group 14. Tree Nuts Group	Almond [a]	VP-38473	2 Foliar (Post-Bloom)	Pollen	12.7	372	N	
				Nectar	0.8	19	N	
Crop Group 20. Oilseed Group	Cotton	VP-38259	2 Foliar	Pollen	246	372	N	
				Nectar	79.4	19	Y	
				Extrafloral Nectar	647	19	Y	

Notes:

Red shading indicates soil or foliar applications that result in pollen or nectar residues that exceed the NOEC.

Green shading indicates soil or foliar applications that do not result in pollen or nectar residues that exceed the NOEC.

[a] Data indicate that post-bloom applications on these crops are not associated with a determination of risk to honey bees; however, these studies do not represent the worst-case scenario for the crop group.

Table 5. Dinotefuran 90th percentile residue values and NOEC exceedances.

Dinotefuran								
Crop Group	Crop	Residue Study Lab ID	Application	Residue Matrix	Residue (μg/Kg)	NOEC (μg/Kg)	Exceedance (Y/N)	Risk
Crop Group 1. Root and Tuber Vegetables Group	Potato	10934.4100	1 Soil	Anthers	56.9	372	N	
Crop Group 8. Fruiting Vegetables Group	Bell Pepper	S16-01167	2 Soil	Pollen	183	372	N	
				Nectar	4.46	71	N	
	Tomato	10934.4103	2 Foliar	Pollen	10438.6	372	Y	
			2 Soil	Pollen	5532.4	372	Y	
Crop Group 9. Cucurbit Vegetables Group	Pumpkin	10934.4104	2 Soil	Pollen	88.3	372	N	
				Nectar	39.0	71	N	
Crop Group 12. Stone Fruits Group	Cherry	10934.4105	2 Foliar	Pollen	130.5	372	N	
				Nectar	12.5	71	N	
Crop Group 13. Berries Group	Blueberry	10934.4107	2 Foliar	Pollen	468.9	372	Y	
				Nectar	470.8	71	Y	
	Cranberry	10934.4101	2 Foliar	Pollen	763.5	372	Y	
				Nectar	780.9	71	Y	
Crop Group 20. Oilseed Group	Cotton	43411B104	2 Foliar	Pollen	6968	372	Y	
				Floral Nectar	81.6	71	Y	
				Extrafloral Nectar	1660	71	Y	

Notes:

Red shading indicates soil or foliar applications that result in pollen or nectar residues that exceed the NOEC.

Green shading indicates soil or foliar applications that do not result in pollen or nectar residues that exceed the NOEC.

6.0 CONCLUSIONS

6.1. Overview by Crop Grouping

In summary, this risk determination document is based upon colony-level risks to honey bees resulting from the consumption of nectar or pollen containing neonicotinoid residues that exceed the colony-level NOEC values. DPR conducted risk determinations for the maximum annual application rate of each agricultural crop group as found on currently registered imidacloprid, clothianidin, thiamethoxam, and dinotefuran product labels (Appendix 3). DPR's risk determinations for soil and foliar applications on registered agricultural crop groupings for imidacloprid, thiamethoxam, clothianidin, and dinotefuran are detailed below and in Table 6. The risk determination process discussed previously states that crop groups are categorized as either having a determination of risk or low risk to honey bee colonies. In Table 6 below, red shading indicates a determination of risk for all crops in the crop group. Green shading indicates a determination of low risk for the entire crop group. Yellow shading is to be considered as having a determination of risk for the crop group, with some crop-specific exceptions. Only crop groups currently registered for agricultural use in California are included in this risk determination, with crop-specific exceptions noted in Table 6.

For imidacloprid, using the 90th percentile as the expected exposure to honey bees, the following crop groups have a determination of low risk: Root and Tuber Vegetables (Crop Group 1), Bulb Vegetables (Crop Group 3), Leafy Vegetables (Except *Brassica* Vegetables) (Crop Group 4), *Brassica* (Cole) Leafy Vegetables (Crop Group 5), Legume Vegetables (Succulent or Dried) (Crop Group 6), Pome Fruits (Crop Group 11), Herbs and Spices (Crop Group 19), and Globe Artichoke. The following crop groups have a determination of risk for imidacloprid: Fruiting Vegetables (Crop Group 8), Cucurbit Vegetables (Crop Group 9), Citrus Fruit (Crop Group 10), Stone Fruits (Crop Group 12), Berries (Crop Group 13), Tree Nuts (Crop Group 14), Oilseed Crops (Crop Group 20), Tropical and Subtropical Fruits with Inedible Peels (Crop Group 24), Hops, Tobacco, and Coffee.

For thiamethoxam, using the 90^{th} percentile as the expected exposure to honey bees, the following crop groups have a determination of low risk: Root and Tuber Vegetables (Crop Group 1), Bulb Vegetables (Crop Group 3), Leafy Vegetables (Except *Brassica* Vegetables) (Crop Group 4), *Brassica* (Cole) Leafy Vegetables (Crop Group 5), Legume Vegetables (Succulent or Dried) (Crop Group 6), Citrus Fruit (Crop Group 10), Globe Artichoke, and Mint. The following crop groups have a determination of risk for thiamethoxam: Fruiting Vegetables (Crop Group 8), Cucurbit Vegetables (Crop Group 9), Pome Fruits (Crop Group 11), Stone Fruits (Crop Group 12), Berries (Crop Group 13), Cereal Grains (Crop Group 15), Oilseed Crops (Crop Group 20), Tropical and Subtropical Fruits with Inedible Peels (Crop Group 24), Hops, and Tobacco.

For clothianidin, using the 90^{th} percentile as the expected exposure to honey bees, the following crop groups have a determination of low risk: Root and Tuber Vegetables (Crop Group 1), Leafy Vegetables (Except *Brassica* Vegetables) (Crop Group 4), *Brassica* (Cole) Leafy Vegetables (Crop Group 5), and Legume Vegetables (Succulent or Dried) (Crop Group 6). The following crop groups have a determination of risk for clothianidin: Cucurbit Vegetables (Crop Group 9), Citrus Fruit (Crop Group 10), Pome Fruits (Crop Group 11), Stone Fruits (Crop Group 12), Berries (Crop Group 13), Tree Nuts (Crop Group 14), Cereal Grains (Crop Group 15), Oilseed Crops (Crop Group 20), Tropical and Subtropical Fruits with Inedible Peels (Crop Group 24), and Tobacco.

For dinotefuran, using the 90^{th} percentile as the expected exposure to honey bees, the following crop groups have a determination of low risk: Root and Tuber Vegetables (Crop Group 1), Bulb Vegetables (Crop Group 3), Leafy Vegetables (Except *Brassica* Vegetables) (Crop Group 4), *Brassica* (Cole) Leafy Vegetables (Crop Group 5), Cucurbit Vegetables (Crop Group 9), and Stone Fruits (Crop Group 12). The following crop groups have a determination of risk for dinotefuran: Fruiting Vegetables (Crop Group 8), Berries (Crop Group 13), and Oilseed Crops (Crop Group 20).

There are crop- and application-specific exceptions for the risk determinations mentioned above. Please refer to Tables 2-6 for more detail on exceptions.

Table 6. Risk determinations for foliar or soil applications of imidacloprid, thiamethoxam, clothianidin, and dinotefuran at the maximum allowed annual application rate based on 90th percentile residue values.

Crop Group	Imidacloprid		Thiamethoxam		Clothianidin		Dinotefuran	
	Risk	Notes	Risk	Notes	Risk	Notes	Risk	Notes
Crop Group 1. Root and Tuber Vegetables Group		d		d				
Crop Group 3. Bulb Vegetables Group		c		c				c
Crop Group 4. Leafy Vegetables (Except *Brassica* Vegetables) Group		c		c		c		c
Crop Group 5. *Brassica* (Cole) Leafy Vegetables		c		c		c		c
Crop Group 6. Legume Vegetables (Succulent or Dried) Group		b				b		
Crop Group 8. Fruiting Vegetables Group								k
Crop Group 9. Cucurbit Vegetables Group		b		h		j		
Crop Group 10. Citrus Fruit Group								
Crop Group 11. Pome Fruits Group						b, e		
Crop Group 12. Stone Fruits Group						b, e		
Crop Group 13. Berries Group		i						
Crop Group 14. Tree Nuts Group		g				e, g		
Crop Group 15. Cereal Grains Group						b		
Crop Group 19. Herbs and Spices		c						
Crop Group 20. Oilseed Group								
Crop Group 24. Tropical and Subtropical Fruit, Inedible Peel Group		f		f		f		
Globe Artichoke [a]		c		c				
Hops [a]		f		f				
Mint [a]				c				
Tobacco [a]		f		f		f		
Coffee [a]		f						

Notes:

Patterned gray shading indicates that the active ingredient is not currently registered for foliar or soil applications on the crop group.

Red shading indicates a determination of risk for all crops in the crop group based on evaluated data.

Yellow shading indicates a determination of risk for the crop group; however, there were crop-specific or application-specific exceptions indicating low risk.

Green shading indicates a determination of low risk for the crop group based on evaluated data.

For additional detail on residue values, please see tables 3, 4, 5, and 6.

[a] Not categorized into a general crop group, according to 40 CFR 180.41 crop group tables.
[b] Risk determination category bridged from thiamethoxam.
[c] No on-field exposure to honey bees expected unless grown for seed.
[d] Risk determination category bridged from clothianidin.
[e] Risk except for post-bloom, pre-harvest applications.
[f] In absence of tier II data and no similar crop groups from which to bridge, the crop group determination defaults to risk to honey bees.
[g] Risk determination category bridged from thiamethoxam stone fruit, as tree nuts and stone fruits are taxonomically related.
[h] Risk except certain applications to pumpkin, muskmelon, and cucumber.
[i] Risk except certain applications to blueberry.
[j] Risk except certain applications to melon, pumpkin, and squash.
[k] Risk except certain applications to bell pepper.

6.2 Seed Treatments and Tree Injection Applications

Risk determinations were only conducted for foliar and soil applications. Risks from seed treatment applications were evaluated in the preliminary pollinator risk assessments published by U.S. EPA (U.S. EPA and DPR, 2016; U.S. EPA, 2017a; U.S. EPA, 2017b). The preliminary assessment for imidacloprid evaluated multiple seed treatment residue studies conducted on corn, canola, and sunflower. These studies generally reported no residues in pollen and nectar above the limit of detection. Values are well below their respective NOEC values, supporting the conclusion that imidacloprid seed treatments pose a low risk to honey bees. The preliminary pollinator risk assessment for clothianidin and thiamethoxam evaluated multiple seed treatment residue studies conducted on corn, sunflower, melon, canola, cotton, and soybean. The resulting residue concentrations are all below the respective NOECs, supporting the conclusion that clothianidin or thiamethoxam seed treatments pose a low risk to honey bee colonies. Dinotefuran is not registered for any seed treatment applications. There have been issues in other states and countries with contact exposure resulting from abraded seed coat dust at planting, but the U.S. EPA has addressed this with best management practices (U.S. EPA and DPR, 2016). DPR has no records of such incidents occurring in California.

DPR considered a single residue study testing a tree injection application in this risk determination. This study measured residues of dinotefuran in pollen and nectar following tree injection applications to cherry trees. Dinotefuran 20SG, EPA Reg. No. 86203-12, was injected into the trunks of cherry trees late in the season (September), before leaf drop, at a rate of 2 grams of product per inch of trunk diameter either at breast height or right below the first trunk bifurcation. Samples of pollen and nectar were collected 165-243 days after the last application. The maximum measured dinotefuran residues resulting from tree injection applications were 31,688 µg/Kg in pollen (201 days after application) and 17,484 µg/Kg in nectar (237 days after application); the corresponding 90th percentile measured residues were 24,894 µg/Kg in pollen and 16,241 µg/Kg in nectar (Lab Study ID 10934.4105; Louque, 2016). These are some of the highest residues noted in pollen and nectar from any application methods on any crops. Currently, no products containing the four neonicotinoids are registered with DPR that allow tree injections to stone fruits or any other agricultural crops in California.

7.0 <u>Considerations for Mitigation</u>

The focus of this document is to identify risks to honey bees at the colony level following applications of imidacloprid, clothianidin, thiamethoxam, and dinotefuran. As stated previously, only worst-case application scenarios, as allowed by currently registered labels in California, were included for analysis. Studies involving less frequent application intervals or lower application rates were excluded from consideration in this document. However, these studies contain valuable data to help inform future mitigation options. For instance, clothianidin residue studies included data on post-bloom applications to several crops, such as peach, almond, and apple. Though these studies were not considered worst-case, and thus not included in the overall risk determination, the resultant residues did not exceed the NOEC and would be categorized as low risk. The information from the additional studies provides potential directions for development of management practices based on the number of applications, frequency of reapplication, soil texture, timing of applications in relation to bloom, and application site.

Though outside the scope of this document, additional analysis of the submitted data would likely provide further science-based mitigation options to reduce risks to honey bees from agricultural applications of nitroguanidine-substituted neonicotinoid pesticides.

8.0 Risk Appraisal

The comparison of neonicotinoid concentrations measured in nectar and pollen of treated crops to NOEC concentrations developed from colony feeding studies is not straightforward for several reasons. First, the duration of exposure in the colony feeding studies was set at six weeks based on bloom duration. Calculating a realistic duration of exposure for pollinating bees is difficult because of differences in blooming periods of crops and commercial beekeeping management practices. The flowering intervals for different crops can be relatively short, such as for early flowering fruit and nut trees, or long, such as for cotton plants, where plants continuously flower throughout the growing season. In addition, during the growing season, managed honey bee colonies are often transported from one flowering crop to another, which extends the duration of exposure. In colony feeding studies, the spiked sugar solutions or pollen patties were regularly replenished throughout the 6-week exposure to ensure the colonies were exposed to a consistent concentration. As indicated by the data, concentrations measured in flowers can be variable, so pollinating honey bee colonies are likely to be exposed to a range of concentrations. In addition, the data presented in this document shows that concentrations measured in the nectar and pollen of certain plants could be orders of magnitude higher than the highest dose levels used in the colony feeding studies. This could result in exposure to residues that are acutely toxic to worker honey bees.

If distributional statistics at the lower to middle portion (i.e. 25th or 50th percentiles) of the measured range in concentrations of treated crops are compared to the NOEC values derived from the colony feeding studies, they could underestimate the potential risk to pollinating honey bee colonies. Conversely, if statistics at the upper end of the distribution are used, they could be overly conservative. Tables 7 to 10 present a visual comparison for the range in potential exceedances that would result from using the 50th, 75th, 90th or 100th (maximum) percentile residue values for each crop and application scenario reviewed for imidacloprid, thiamethoxam, clothianidin, and dinotefuran. The comparison between the 50th and 100th percentile to the NOEC conforms to the observation that the 50th percentile would likely not be protective, whereas, the 100th percentile is potentially overprotective.

The concentrations calculated for each of the percentiles are presented in Appendix 11. Of significance is the rather large range in values that was measured in some of the treated crops. Both nectar and pollen values at the highest percentiles were measured in the parts per million, values that would cause acute toxicity.

In summary, the 50th percentile concentration would likely not be protective of honey bee colonies, especially in light of extremely high values that were measured for certain combinations of crop and application methods. On the other hand, the maximum concentration value would likely be overly protective because of complications in the comparison of total exposure to NOEC values generated from the colony feeding studies. The uncertainty is caused by difficulties in calculating the total magnitude and duration of exposure, as there are potentially large differences in exposure durations between the bees in the colony feeding study and those bees foraging on the flowers of the crops they are pollinating. Use of the 90^{th} percentile residue values indicate either a determination of risk or a determination of low risk for the studies evaluated and appears to be a realistic, yet protective approach.

Table 7. Imidacloprid comparison of NOEC exceedances based on maximum and 50th, 75th, and 90th percentile values for each crop and application scenario, based on acceptable data.

Imidacloprid						
Crop Group	Crop	Application Type	Exceedance Category			
			50%	75%	90%	Max
Crop Group 8. Fruiting Vegetables Group	Tomato	1 Soil + 2 Foliar				
Crop Group 10. Citrus Fruit Group	Orange	2 Foliar (Pre-Bloom)				
	Citrus [a]	1 Soil				
Crop Group 11. Pome Fruits Group	Apple	1 Soil + 2 Foliar				
Crop Group 12. Stone Fruits Group	Stone Fruit [b]	1 Soil + 2 Foliar				
	Cherry	5 Foliar				
Crop Group 13. Berries Group	Blueberry	1 Soil				
	Strawberry	1 Soil				
Crop Group 20. Oilseed Group	Cotton	1 Soil + 3 Foliar (At Bloom)				
		5 Foliar (Pre-Bloom)				
Crop Groups With Data Gaps						
Crop Group 1. Root and Tuber Vegetables Group	N/A	N/A				
Crop Group 3. Bulb Vegetables Group	N/A	N/A				
Crop Group 4. Leafy Vegetables (Except *Brassica* Vegetables) Group	N/A	N/A				
Crop Group 5. *Brassica* (Cole) Leafy Vegetables	N/A	N/A				
Crop Group 6. Legume Vegetables (Succulent or Dried) Group	N/A	N/A				
Crop Group 9. Cucurbit Vegetables Group	N/A	N/A				
Crop Group 14. Tree Nuts Group	N/A	N/A				
Crop Group 19. Herbs and Spices	N/A	N/A				
Crop Group 24. Tropical and Subtropical Fruit, Inedible Peel Group	N/A	N/A				
Globe Artichoke	N/A	N/A				
Hops	N/A	N/A				
Tobacco	N/A	N/A				
Coffee	N/A	N/A				

Notes:

Red shading indicates soil or foliar applications that result in pollen or nectar residues that exceed the NOEC.

Green shading indicates soil or foliar applications that do not result in pollen or nectar residues that exceed the NOEC.

[a] Residue study was conducted on multiple crops within the crop group, including orange, tangerine, grapefruit, tangelos, and lemon. However, data was not analyzed by individual crop due to limited replication.

[b] Residue study was conducted on multiple crops within the crop group, including cherry, plum, apricot, and peach. However, data was not analyzed by individual crop due to limited replication.

Table 8. Thiamethoxam comparison of NOEC exceedances based on maximum and 50th, 75th, and 90th percentile values for each crop and application scenario, based on acceptable data.

Thiamethoxam						
Crop Group	**Crop**	**Application Type**	**Exceedance Category**			
			50%	**75%**	**90%**	**Max**
Crop Group 6. Legume Vegetables (Succulent or Dried) Group	Soybean	2 Foliar				
Crop Group 8. Fruiting Vegetables Group	Tomato	2 Foliar				
		1 Soil				
	Pepper	1 Soil				
Crop Group 9. Cucurbit Vegetables Group	Cucumber	1 Soil				
		2 Foliar				
	Muskmelon	1 Soil				
	Pumpkin	1 Soil				
		2 Foliar				
	Summer Squash	1 Soil				
Crop Group 10. Citrus Fruit Group	Citrus [a]	1 Soil				
	Sweet Orange	2 Foliar				
Crop Group 11. Pome Fruits Group	Apple	1 Foliar				
Crop Group 12. Stone Fruits Group	Stone Fruit [b]	2 Foliar				
Crop Group 13. Berries Group	Blueberry	3 Foliar				
	Strawberry	3 Foliar				
		1 Soil				
	Cranberry	3 Foliar				
Crop Group 15. Cereal Grains Group	Corn	Seed + 2 Foliar				
Crop Group 20. Oilseed Group	Cotton	2 Foliar				
Crop Groups With Data Gaps						
Crop Group 1. Root and Tuber Vegetables Group	N/A	N/A				
Crop Group 3. Bulb Vegetables Group	N/A	N/A				
Crop Group 4. Leafy Vegetables (Except *Brassica* Vegetables) Group	N/A	N/A				
Crop Group 5. *Brassica* (Cole) Leafy Vegetables	N/A	N/A				
Crop Group 24. Tropical and Subtropical Fruit, Inedible Peel Group	N/A	N/A				
Globe Artichoke	N/A	N/A				
Hops	N/A	N/A				
Mint	N/A	N/A				
Tobacco	N/A	N/A				

Notes:

Red shading indicates soil or foliar applications that result in pollen or nectar residues that exceed the NOEC.

Green shading indicates soil or foliar applications that do not result in pollen or nectar residues that exceed the NOEC.

[a] Residue study was conducted on multiple crops within the crop group, including orange and lemon. However, data was not analyzed by individual crop due to limited replication.

[b] Residue study was conducted on multiple crops within the crop group, including peach, plum, cherry, and prune. However, data was not analyzed by individual crop due to limited replication.

Table 9. Clothianidin comparison of NOEC exceedances based on maximum and 50th, 75th, and 90th percentile values for each crop and application scenario, based on acceptable data.

Clothianidin						
Crop Group	Crop	Application Type	Exceedance Category			
			50%	75%	90%	Max
Crop Group 1. Root and Tuber Vegetables Group	Potato	1 Soil				
Crop Group 9. Cucurbit Vegetables Group	Cucumber	1 Soil				
	Melon	1 Soil				
	Squash	1 Soil				
	Pumpkin	1 Soil				
		1 Soil (At Planting)				
		2 Foliar				
		1 Soil (Post-Emergence)				
Crop Group 13. Berries Group	Grape	1 Soil				
		1 Foliar (Pre-Bloom)				
Crop Group 20. Oilseed Group	Cotton	2 Foliar				
Crop Groups With Data Gaps						
Crop Group 4. Leafy Vegetables (Except *Brassica* Vegetables) Group	N/A	N/A				
Crop Group 5. *Brassica* (Cole) Leafy Vegetables	N/A	N/A				
Crop Group 6. Legume Vegetables (Succulent or Dried) Group	N/A	N/A				
Crop Group 11. Pome Fruits Group [a]	N/A	N/A				
Crop Group 12. Stone Fruits Group [b]	N/A	N/A				
Crop Group 14. Tree Nuts Group [c]	N/A	N/A				
Crop Group 15. Cereal Grains Group	N/A	N/A				
Crop Group 24. Tropical and Subtropical Fruit, Inedible Peel Group	N/A	N/A				
Tobacco	N/A	N/A				

Notes:

Red shading indicates soil or foliar applications that result in pollen or nectar residues that exceed the NOEC.

Green shading indicates soil or foliar applications that do not result in pollen or nectar residues that exceed the NOEC.

[a] Risk except post-bloom foliar applications to apple.

[b] Risk except post-bloom foliar applications to peach.

[c] Risk except post-bloom foliar applications to almond.

Table 10. Dinotefuran comparison of NOEC exceedances based on maximum and 50th, 75th, and 90th percentile values for each crop and application scenario, based on acceptable data.

Dinotefuran						
Crop Group	**Crop**	**Application Type**	**Exceedance Category**			
			50%	**75%**	**90%**	**Max**
Crop Group 1. Root and Tuber Vegetables Group	Potato	1 Soil				
Crop Group 8. Fruiting Vegetables Group	Bell Pepper	2 Soil				
	Tomato	2 Soil				
		2 Foliar				
Crop Group 9. Cucurbit Vegetables Group	Pumpkin	2 Soil				
Crop Group 12. Stone Fruits Group	Cherry	2 Foliar				
Crop Group 13. Berries Group	Blueberry	2 Foliar				
	Cranberry	2 Foliar				
Crop Group 20. Oilseed Group	Cotton	2 Foliar				
Crop Groups With Data Gaps						
Crop Group 3. Bulb Vegetables Group	N/A	N/A				
Crop Group 4. Leafy Vegetables (Except *Brassica* Vegetables) Group	N/A	N/A				
Crop Group 5. *Brassica* (Cole) Leafy Vegetables	N/A	N/A				

Notes:

Red shading indicates soil or foliar applications that result in pollen or nectar residues that exceed the NOEC.

Green shading indicates soil or foliar applications that do not result in pollen or nectar residues that exceed the NOEC.

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Appendix 1. Reevaluation Letter Initiating the Reevaluation of Imidacloprid, Clothianidin, Thiamethoxam, and Dinotefuran

dpr

Department of Pesticide Regulation

Mary-Ann Warmerdam
Director

Arnold Schwarzenegger
Governor

California Notice 2009-02

POST UNTIL March 31, 2009

NOTICE OF DECISION TO INITIATE REEVALUATION OF CHEMICALS IN THE NITROGUANIDINE INSECTICIDE CLASS OF NEONICOTINOIDS.

Pursuant to Section 6220, et seq., Title 3. California Code of Regulations, the Director of the Department of Pesticide Regulation (DPR) notices her decision to initiate a reevaluation of certain pesticide products within the nitroguanidine insecticide class of neonicotinoids and containing the following active ingredients: imidacloprid, clothianidin, dinotefuran, and thiamethoxam. Interested persons may comment on this decision up to and including the date shown on the top-right corner of this notice to the Department of Pesticide Regulation, Pesticide Registration Branch, 1001 I Street, P.O. Box 4015, Sacramento, California 95812-4015.

REEVALUATION

DPR is hereby commencing a reevaluation of chemicals in the nitroguanidine insecticide class of neonicotinoids and containing the following active ingredients: imidacloprid, clothianidin, dinotefuran, and thiamethoxam. This reevaluation involves 50 registrants and 282 pesticide products. DPR determined that the number of products included in this reevaluation were too numerous to list within this notice. A list of products included in the reevaluation is available upon written request to the address listed above or on DPR's Web site at: <http://www.cdpr.ca.gov/docs/registration/reevaluation/chemicals/neonicotinoids.htm>.

BASIS OF REEVALUATION

In 2008, DPR received an adverse effects disclosure pursuant to Federal Insecticide Fungicide and Rodenticide Act (FIFRA) section 6(a)(2) and Food and Agricultural Code section 12825.5 regarding the active ingredient imidacloprid. The disclosure included twelve residue and two combination residue, honey, bumble bee studies of imidacloprid use on a number of ornamental plants. DPR's evaluation of the data noted two critical findings. One, high levels of imidacloprid in leaves and blossoms of treated plants, and two, increases in residue levels over time.

Imidacloprid levels in leaves and blossoms varied depending on the application rate and the type of plant, but the data indicate that residues in some plants measured higher than 4 parts per million (ppm). The data also indicate that when using soil application methods, imidacloprid residues remained relatively low for the first six months after application, followed by a dramatic increase that remained stable in some cases for more than 500 days after treatment. Where imidacloprid was applied to the soil, no significant decline in residue levels was observed in any of the studies, even in studies where residues were tested at 540 days after treatment. DPR found that the treatment rates used in the studies where high imidacloprid residue levels were found in

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leaves and blossoms, were comparable to application rates found on currently registered labels for orchards, assuming the orchards were planted at a density of 200 trees per acre or fewer. The data indicate that use of imidacloprid on an annual basis may be additive, in that significant residues from the previous use season appear to be available to the treated plant. DPR also received preliminary information from a University of California at Riverside researcher who is investigating imidacloprid residues in eucalyptus nectar and pollen. The researcher's preliminary results indicate imidacloprid residues in eucalyptus nectar at levels of up to 550 parts per billion (ppb).

Based upon data on file, DPR estimates the lethal concentration of imidacloprid needed to kill 50 percent of a test population (LC_{50}) of honey bees is 185 ppb[1]. In their everyday foraging and pollination activities, honey bees collect both nectar and pollen from flowering plants. If the imidacloprid residue levels in a plant's nectar and pollen are similar to those found in the leaves and blossoms of the plants described in the adverse effects data, the levels are well above the estimated LC_{50} for honey bees. The levels found in some of the plants were more than twenty times the estimated honey bee LC_{50} of 185 ppb.

All of the neonicotinoids share many of the same characteristics as imidacloprid. However, the three other neonicotinoids included in this reevaluation, clothianidin, dinotefuran, and thiamethoxam, are in the same chemical family (nitroguanidines) as imidacloprid. These three other active ingredients, in particular, have soil mobility characteristics and half-lives that are very similar to imidacloprid. Based on available data, DPR scientists believe these active ingredients would have the same potential residue concerns as imidacloprid. Data also indicate that these active ingredients are similar to imidacloprid in toxicity to honey bees. Due to the chemical and toxicological similarities between imidacloprid and the other neonicotinoids, DPR is providing those registrants with the option of generating data on their own chemicals or providing/relying upon data generated using a surrogate nitroguanidine.

DPR exempted the following formulation categories and product types from the reevaluation:

1. Formulated as a gel or impregnated in a strip;
2. Termiticide;
3. Flea control products combined with rodenticide;
4. Pet spot applications;
5. Ant and roach baits;
6. Premise application for control of nuisance pests; or,
7. Manufacturing use only products.

[1] The LC_{50} was estimated by converting the acute oral LD_{50} (the amount of a material that causes the death of 50 percent of a test population) to a concentration in nectar using the standard consumption model used in bee feeding studies.

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DPR exempted the above types of products from the reevaluation because the manner in which the products are formulated or applied makes it unlikely that the neonicotinoid will move into plants that bloom or be a source of forage for honey bees and pollinators.

DPR has not yet made a final decision as to the data it will require registrants to conduct pursuant to this reevaluation. In general, DPR intends to require registrants to analyze residues from the nectar and pollen of a representative number of crops grown in California in order to better understand the impact of neonicotinoids on honey bees. In addition, DPR plans to require acute toxicity studies on various honey bee life stages.

DPR plans to work closely with the United States Environmental Protection Agency's (U.S. EPA's) Office of Pesticide Programs throughout the reevaluation process. U.S. EPA's registration review docket for imidacloprid <http://www.epa.gov/oppsrrd1/registration_review/imidacloprid/index.htm> opened in December 17, 2008, and the docket for nithiazine is scheduled to be opened in March 2009. In order to better ensure a "level playing field" for the neonicotinoid class as a whole, and to best take advantage of new research as it becomes available, U.S. EPA has scheduled the docket openings for the remaining neonicotinoids (acetamiprid, clothianidin, dinotefuran, thiacloprid, and thiamethoxam) for fiscal year 2012.

For information regarding the reevaluation process, please contact either Ms. Denise Webster, by e-mail at <dwebster@cdpr.ca.gov> or by telephone at (916) 324-3522, or Ms. Alveena Prasad, by e-mail at <aprasad@cdpr.ca.gov> or by telephone at (916) 324-3905.

Original signed by
Ann M. Prichard, Chief
Pesticide Registration Branch
(916) 324-3931

February 27, 2009
Date

cc: Ms. Denise Webster, Program Specialist
Ms. Alveena Prasad, Environmental Scientist

Appendix 2. California Food and Agricultural Code (FAC) section (§) 12838

Assembly Bill No. 1789

CHAPTER 578

An act to add Section 12838 to the Food and Agricultural Code, relating to pesticides.

[Approved by Governor September 26, 2014. Filed with Secretary of State September 26, 2014.]

Legislative counsel's digest

AB 1789, Williams. Pesticides: neonicotinoids: reevaluation: determination: control measures.

Existing law requires pesticides to be registered by the Department of Pesticide Regulation. Existing law requires that a pesticide be thoroughly evaluated prior to registration, and provides for the continued evaluation of registered pesticides.

This bill would require the department, by July 1, 2018, to issue a determination with respect to its reevaluation of neonicotinoids. The bill would require the department, on or before 2 years after making this determination, to adopt any control measures necessary to protect pollinator health.

The bill would require the department to submit a report to the appropriate committees of the Legislature if the department is unable to adopt those control measures and to update the report annually until the department adopts those control measures.

The people of the State of California do enact as follows:

SECTION 1. (a) The Legislature finds and declares all of the following:

(1) Honey bees are vital to the pollination of many of California's crops, which are critical to our national food system and essential to the economy of the state.

(2) Annual colony losses from 2006 to 2011, inclusive, averaged about 33 percent each year, which is more than double what is considered sustainable according to the United States Department of Food and Agriculture.

(3) Scientists now largely agree that a combination of factors is to blame for declining pollinator health, including lack of varied forage and nutrition, pathogens and pests such as the Varroa mite, and chronic and acute exposure to a variety of pesticides.

(4) Based on data submitted to the Department of Pesticide Regulation showing a potential hazard to honey bees, the department initiated a

Appendix 2. California Food and Agricultural Code (FAC) section (§) 12838

reevaluation process for four neonicotinoid compounds in 2009: imidacloprid, thiamethoxam, clothianidin, and dinotefuran.

(b) It is the intent of the Legislature to set a timeline for completion of the reevaluation of neonicotinoid compounds to ensure that the Department of Pesticide Regulation completes a thorough, scientifically sound, and timely analysis of the effects of neonicotinoids on pollinator health.

SEC. 2. Section 12838 is added to the Food and Agricultural Code, to read:

12838. (a) On or before July 1, 2018, the department shall issue a determination with respect to its reevaluation of neonicotinoids.

(b) (1) Within two years after making the determination specified in subdivision (a), the department shall adopt any control measures necessary to protect pollinator health.

(2) If the department is unable to adopt necessary control measures within two years as required in paragraph (1), the department shall submit a report to the appropriate committees of the Legislature setting forth the reasons the requirement of paragraph (1) has not been met.

(3) The department shall update the report submitted to the appropriate committees of the Legislature pursuant to paragraph (2) every year until the department adopts the necessary control measures specified in paragraph (1).

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

The neonicotinoid informational use tables include crop groups that have been defined in Title 40 of the Code of Federal Regulations (40 CFR) Part 180.41. In accordance with the risk determination, a single crop or a subset of a crop group could represent an entire crop group listed in the tables. Crop groups and use rates in the tables are representative of agricultural commodities that are currently registered for use in California. 40 CFR Part 180.41 does not categorize hops, globe artichoke, and peanuts into crop groups as these are seen as miscellaneous commodities.

Imidacloprid					
Crop groups listed		Maximum single application rate (soil or foliar)	Maximum annual or seasonal application rate (soil or foliar)	Minimum reapplication interval	Restrictions
Berry and Small Fruit	Low Growing Berry	0.047 lbs ai/A (foliar) 0.50 lbs ai/A (soil)	0.14 lbs ai/A (foliar) 0.50 lbs ai/A (soil)	5 days	• When applied as a soil post-harvest treatment, the maximum single application rate the maximum annual seasonal application rate is 0.38 lb ai/A. • Do not use both soil application methods on the same crop in the same season. • Do not apply during bloom or within 10 days prior to bloom or when bees are foraging.
	Bushberry	0.1 lbs ai/A (foliar) 0.5 lbs ai/A (soil)	0.5 lbs ai/A (foliar) 0.5 lbs ai/A (foliar)	7 days	• Do not apply pre-bloom or during bloom or when bees are foraging.
	Caneberry	0.1 lbs ai/A (foliar) 0.5 lbs ai/A (soil)	0.3 lbs ai/A (foliar) 0.5 lbs ai/A (soil)	7 days	• Do not apply pre-bloom or during bloom or when bees are foraging.
	Small fruit vine climbing subgroup except fuzzy kiwifruit	0.05 lbs ai/A (foliar) 0.5 lbs ai/A (soil)	0.1 lbs ai/A (foliar) 0.5 lbs ai/A (soil)	14 days	• Apply with ground application equipment only.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Imidacloprid				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Citrus Fruit	0.25 lbs ai/A (foliar) 0.50 lbs ai/A (soil) 0.0013 lbs ai/ft^3 (soil; containerized)	0.50 lbs ai/A (foliar) 0.50 lbs ai/A (soil) 0.0037 lbs ai/plant (soil; containerized)	10 days	• Do not apply during bloom or within 10 days prior to bloom or when bees are foraging.
Oilseed	0.063 lbs ai/A (foliar) 0.33 lbs ai/A (soil) 0.5 lbs ai/100 lb seed (seed treatment; cotton) 1 lbs ai/100 lbs seed (seed treatment; canola, rapeseed, mustard seed, flax, crambe, borage) 0.5 mg ai/seed (seed treatment; safflower, sunflower)	0.31 lbs ai/A (foliar) 0.33 lbs ai/A (soil)	7 days	• Regardless of formulation or method of application, apply no more than 0.5 lb. active ingredient per acre per year, including seed treatment, soil, and foliar uses. • Do not graze treated fields after any application imidacloprid
Cucurbit Vegetable	0.38 lbs ai/A (soil)	0.38 lbs ai/A (soil)		• Not for use on crops grown for seed unless allowed by state-specific 24(c) labeling.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Imidacloprid				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Fruiting Vegetable	0.075 lbs ai/A (foliar) 0.38 lbs ai/A (soil) 0.5 lbs ai/A (soil; okra and peppers)	0.24 lbs ai/A (foliar) 0.38 lbs ai/A (soil) 0.5 lbs ai/A (soil; okra and peppers)	5 days	• Not for use on crops grown for seed unless allowed by state-specific 24(c) labeling.
Pome Fruit	0.1 lbs ai/A (foliar) 0.25 lbs ai/A (foliar; pear) 0.38 lbs ai/A (soil)	0.5 lbs ai/A (foliar) 0.5 lbs ai/A (foliar; pear) 0.38 lbs ai/A (soil)	10 days	• Do not apply pre-bloom or during bloom or when bees are foraging.
Stone Fruit	0.1 lbs ai/A (foliar) 0.1 lbs ai/A (foliar; apricot, nectarine, and peach) 0.38 lbs ai/A (soil)	0.5 lbs ai/A (foliar) 0.3 lbs ai/A (foliar; apricot, nectarine, and peach) 0.38 lbs ai/A (soil)	10 days 7 days (apricot, nectarine, and peach)	• The maximum annual foliar rate allowed per year for apricot, nectarine, and peach: 0.3 lb ai/A • Do not apply pre-bloom or during bloom or when bees are foraging

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Imidacloprid				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Cereal Grains	0.53 lbs ai/100 lbs seed (seed treatment; field corn) 0.94 lbs ai/100 lbs seed (seed treatment; wheat, barley, oats, rye, triticale) 0.25 lbs ai/100 lbs seed (seed treatment; sorghum, millet) 0.2 lbs ai/100,000 of pelleted seed (seed treatment; sugar beet) 0.094 lbs ai/100,000 of raw seed (seed treatment; sugar beet) 0.25 lbs ai/100 lbs seed (seed treatment; popcorn) 0.25 lbs ai/100 lbs seed (seed treatment; sweet corn)			• Corn: Do not graze or feed livestock on treated areas for 45 days after planting. • Wheat, barley, oats, rye, triticale, sorghum, and millet: Do not graze or feed livestock on treated areas for 45 days after planting. • The maximum application rate for imidacloprid (including seed treatments, foliar applications, and soil applications) is 0.5 pound active ingredient per acre per calendar year.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Imidacloprid				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Tree Nut Group	0.1 lbs ai/A (foliar) 0.50 lbs ai/A (soil)	0.36 lbs ai/A (foliar) 0.50 lbs ai/A (soil)	6 days	• Do not apply to almonds • Do not apply pre-bloom or during bloom or when bees are foraging.
Brassica (Cole) Leafy Vegetable	0.047 lbs ai/A (foliar) 0.38 lbs ai/A (soil)	0.24 lbs ai/A (foliar) 0.38 lbs ai/A (soli)	5 days	• Not for use on crops grown for seed unless allowed by state-specific 24(c) labeling.
Tropical and Subtropical Fruit, Inedible Peel Group	0.1 lbs/A (foliar) 0.1lbs ai/A (foliar; pomegranate) 0.5 lbs ai/A (soil)	0.5 lbs ai/A (foliar) 0.3 lbs ai/A (foliar; pomegranate) 0.5 lbs ai/A (soil)	7 days 14 days (banana and plantain)	• Do not apply pre-bloom or during bloom or when bees are foraging.
Root and Tuber Vegetables	0.047 lbs ai/A (foliar; potato) 0.044 lbs ai/A (foliar) 0.044 lbs ai/A (foliar; radish) 0.31 lbs ai/A (soil; potato) 0.38 lbs ai/A (soil) 0.18 lbs ai/A (soil; sugar beet)	0.2 lbs ai/A (foliar; potato) 0.13 lbs ai/A (foliar) 0.044 lbs ai/A (foliar; radish) 0.31 lbs ai/A (soil; potato) 0.38 lbs ai/A (soil) 0.18 lbs ai/A (soil; sugar beet)	7 days (potato) 5 days	• Not for use on crops grown for seed unless allowed by state-specific 24(c) labeling. • Side-dress no more than 0.3 fl oz/1000 row feet no later than 45 days after planting. • Sugar beet: No not apply immediately prior to bud opening or during bloom or when bees are foraging.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Imidacloprid				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Root and Tuber Vegetables, *continued*	0.26 lbs ai/A (seed treatment; potato) 0.25 lbs ai/100 lbs seed (seed treatment; carrot)			
Leafy Vegetable (Except *Brassica* Vegetable)	0.047 lbs ai/A (foliar) 0.38 lbs ai/A (soil)	0.24 lbs ai/A (foliar) 0.38 lbs ai/A (soil)	5 days	• Not for use on crops grown for seed unless allowed by state-specific 24(c) labeling.
Legume Vegetables (Succulent or Dried)	0.044 lbs ai/A (foliar) 0.047 lb ai/A (foliar; soybean) 0.38 lbs ai/A (soil) 0.125 lbs ai/100 lbs seed (seed treatment; soybean)	0.13 lbs ai/A (foliar) 0.14 lbs ai/A (foliar; soybean) 0.38 lbs ai/A (soil)	7 days	• Not for use on crops grown for seed unless allowed by state-specific 24(c) labeling. • Foliar and soil application on Soybean not permitted in California unless otherwise directed by state specific 24(c) labeling. • Soybean: Do not graze or feed livestock on soybean forage or hay.
Herbs and Spices	0.044 lbs ai/A (foliar) 0.38 lbs ai/A (soil)	0.13 lbs ai/A (foliar) 0.38 lbs ai/A (soil)	5 days	
Bulb Vegetables	0.5 lbs ai/A (soil)	0.5 lbs ai/A (soil)		• Not for use on crops grown for seed unless by state-specific 24(c) labeling.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Imidacloprid				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Tobacco	0.05 lbs ai/A (foliar) 0.016 lbs ai/1,000 plants (soil)	0.28 lbs ai/A (foliar) 0.5 lbs ai/A (soil)	7 days	
Coffee	0.1 lbs ai/A (foliar) 0.5 lbs ai/A (soil)	0.5 lbs ai/A (foliar) 0.5 lbs ai/A (soil)	7 days	• Do not apply pre-bloom or during bloom or when bees are foraging.
Hops	0.1 lbs ai/A (foliar) 0.3 lbs ai/A (soil)	0.3 lbs ai/A (foliar) 0.3 lbs ai/A (soil)	21 days	
Globe Artichoke	0.125 lbs ai/A (foliar)	0.5 lbs ai/A (foliar)	14 days	

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Thiamethoxam				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Cucurbit Vegetables	0.086 lbs ai/A (foliar) 0.172lbs ai/A (soil) 0.75 mg ai/seed, Do not exceed 0.164 lbs ai/A (seed treatment)	0.172 lbs ai/A (foliar) 0.172lbs ai/A (soil)	5 days	• Refer to Pollinator Precautions section. • Refer to Resistance Management section.
Citrus Fruit	0.086 lbs ai/A (foliar) 0.172lbs ai/A (soil)	0.172 lbs ai/A (foliar) 0.172lbs ai/A (soil)	7 days	• Thiamethoxam is highly toxic to bees exposed to direct treatment on blooming crops. Do not apply during pre-bloom or during bloom when bees are actively foraging. Do not apply thiamethoxam or allow it to drift to blooming crops or weeds if bees are foraging in for adjacent to the treatment area. This is especially critical if there are adjacent orchards that are blooming. After a thiamethoxam application, wait at least 5 days before placing beehives in the treated field. If bees are foraging in the ground cover and it contains any blooming plants or weeds, always remove flowers before making an application. This may be accomplished by mowing, disking, mulching, flailing, or applying a labeled herbicide.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Thiamethoxam					
Crop groups listed		Maximum single application rate (soil or foliar)	Maximum annual or seasonal application rate (soil or foliar)	Minimum reapplication interval	Restrictions
Oilseed		0.063 lbs ai/A (foliar) 0.375 mg ai/seed (Seed treatment; Cotton) 0.25 mg ai/seed (seed treatment; Sunflower) 0.039 lbs ai/100 lbs seed (seed treatment; safflower)	0.125 lbs ai/A (foliar) 0.075 lbs ai/A (seed treatment; cotton) 0.14 lbs ai/A (seed treatment; sunflower) 0.14 lbs ai/A (seed treatment; safflower)	5 days Do not apply a neonicotinoid insecticide within 45 days of planting seed treated cotton seeds	• To protect the Preble's Meadow Jumping Mouse, sunflower seed treated with Cruiser 5FS Alfalfa may not be planted in Elbert or Weld Counties in Colorado. • Treated sunflower seed must be planted at a minimum depth of one inch.
Stone Fruit		0.086 lbs ai/A (foliar)	0.172 lbs ai/A (foliar)	7 days	• Refer to Pollinator Precautions section. • Refer to Resistance Management section.
Berry and Small Fruit	Small fruit vine climbing subgroup except fuzzy kiwifruit	0.055 lbs ai/A (foliar) 0.266 lbs ai/A (soil)	0.109 lbs ai/A (foliar) 0.266 lbs ai/A (soil)	14 days	• Refer to Pollinator Precautions section. • Refer to Resistance Management section.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Thiamethoxam					
Crop groups listed		Maximum single application rate (soil or foliar)	Maximum annual or seasonal application rate (soil or foliar)	Minimum reapplication interval	Restrictions
Berry and Small Fruit, *continued*	Low growing berry subgroup	0.063 lbs ai/A (foliar) 0.188 lbs ai/A (soil)	0.188 lbs ai/A (foliar) 0.188 lbs ai/A (soil)	10 days	• Do not apply by air • Refer to Pollinator Precautions section. • Refer to Resistance Management section.
	Bushberry	0.063 lbs ai/A (foliar) 0.188 lbs ai/A (soil)	0.188 lbs ai/A (foliar) 0.188 lbs ai/A (soil)	7 days	• Apply after bud-break, but prior to the beginning of bloom (first open blooms) • Refer to Pollinator Precautions section. • Refer to Resistance Management section.
Fruiting Vegetables		0.086 lbs ai/A (foliar) 0.172lbs ai/A (soil)	0.172 lbs ai/A (foliar) 0.172 lbs ai/A (soil)	5 days	• Refer to Pollinator Precautions section. • Refer to Resistance Management section.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Thiamethoxam				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Legume Vegetables (Succulent or Dried)	0.031 lbs ai/A (foliar) 0.05 lbs ai/100 lbs seed, Do not exceed 0.075 lbs ai/A (seed treatment) 0.05 lbs ai/100 lbs seed, Do not exceed 0.083 lbs ai/A (seed treatment; soybean)	0.125 lbs ai/A (foliar)	7 days Do not apply a neonicotinoid insecticide within 45 days of planting seed treated with Cruiser 5FS.	• Refer to Pollinator Precautionary section • Refer to Resistance Management section
Leafy Vegetables (Except Brassica Vegetables)	0.086 lbs ai/A (foliar) 0.172lbs ai/A (soil)	0.172 lbs ai/A (foliar) 0.172lbs ai/A (soil)	7 days	• Refer to Pollinator Precautions section. • Refer to Resistance Management section.
Bulb Vegetables	0.266 lbs ai/A (seed treatment)			
Brassica (Cole) Leafy Vegetables	0.086 lbs ai/A (foliar) 0.172 lbs ai/A (soil)	0.172 lbs ai/A (foliar) 0.172 lbs ai/A (soil)	7 days	• Refer to Pollinator Precautions section. • Refer to Resistance Management section.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

<table>
<tr><th colspan="6">Thiamethoxam</th></tr>
<tr><th colspan="2">Crop groups listed</th><th>Maximum single application rate (soil or foliar)</th><th>Maximum annual or seasonal application rate (soil or foliar)</th><th>Minimum reapplication interval</th><th>Restrictions</th></tr>
<tr><td rowspan="2">Root and Tuber Vegetables</td><td>Tuberous and Corm</td><td>0.047 lbs ai/A (foliar)
0.125 lbs ai/A (soil)
0.125 lbs ai/A (seed treatment)</td><td>0.094 lbs ai/A (foliar)
0.125 lbs ai/A (soil)</td><td>7 days</td><td>• Refer to Pollinator Precautions section.
• Refer to Resistance Management section.
• Do not use this thiamethoxam on potato seed in Nassau or Suffolk County, New York.</td></tr>
<tr><td>Root Vegetables</td><td>0.063 lbs ai/A (foliar)
0.188 lbs ai/A (soil)
0.63 lbs ai/A (foliar; radish)
0.102 lbs ai/A (soil; radish)
70 gram ai/100,000 seeds; Do not exceed 0.206 lbs ai/A (seed treatment; Sugar Beets)</td><td>0.125 lbs ai/A (foliar)
0.188 lbs ai/A (soil)
0.063 lbs ai/A (foliar; radish)
0.102 lbs ai/A (soil; radish)</td><td>7 days</td><td></td></tr>
</table>

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Thiamethoxam				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Pome Fruit	0.086 lbs ai/A (foliar)	0.258 lbs ai/A (foliar)	10 days	• Refer to Pollinator Precautionary Section • Refer to resistance management section
Tropical and Subtropical Fruit, Inedible Peel Group	0.063 lbs ai/A (foliar)	0.188 lbs ai/A (foliar)	7 days	• Refer to Pollinator Precautionary Section • Refer to resistance management section
Globe Artichoke	0.047 lbs ai/A (foliar)	0.094 lbs ai/A (foliar)	7 days	• Refer to Pollinator Precautions section. • Refer to Resistance Management section.
Peanuts	0.29 mg ai/seed; Do not exceed 0.08 lbs ai/A (seed treatment)			• Do not use a thiamethoxam rate that will result in more than 0.08 lbs ai/A (35.0 grams ai/A) per season, based on a maximum seeding rate of 120,700 seeds/acre. • Do not use in hopper box, planter box, slurry box, or other farmer applied applications. Apply thiamethoxam seed treatment in commercial seed treatment facilities only.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Thiamethoxam				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Cereal Grains	0.0625 lbs ai/A (foliar; barley) 0.052 lbs ai/100 lbs seeds, Do not exceed 0.52 lbs ai/A (seed treatment; barley) 0.80 mg ai/kernel, Do not exceed 0.165 lbs ai/A (seed treatment; corn) 0.03 mg ai/seed, Do not exceed 0.17 lb ai/A (seed treatment; rice) 0.093 mg ai/seed, Do not exceed 0.03 lbs ai/A (seed treatment; sorghum) 0.052 lbs ai/100 lbs seeds, Do not exceed	0.125 lbs ai/A (foliar; barely)	7 days	• Refer to Pollinator Precautionary Section • Refer to resistance management section • For field, pop, seed and sweet corn, do not use a cruiser rate that will result in more than 0.21 lb ai/A based on a maximum seeding rate for sweet corn of 75,000 seeds/acre. • Do not apply more than 215 gallons per 8 hour day for seed treatments utilizing a closed system. • Do not apply more than 38 gallons of thiamethoxam per 8 hour day for seed treatments utilizing an open system. If it is necessary to apply more than 28 gallons of cruiser per 8 hour day, a closed system must be used • A closed system must be used for commercial treatment of sorghum seed

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Thiamethoxam				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Cereal Grains, *continued*	0.08 lbs ai/A (seed treatment; wheat) 0.052 lbs ai/100 lbs seeds, Do not exceed 0.04 lbs ai/A (seed treatment; buckwheat, pearl millet, proso millet, oats, rye, tesinte, triticale, and wild rice)			• Not for use in water seeded rice production. Do not plant or sow thiamethoxam treated rice seed by aerial application equipment. Do not use treated fields for the aquaculture of edible fish and crustacean.
Hops	0.125 lbs ai/A (soil)	0.125 lbs ai/A (soil)		
Tobacco	0.047 lbs ai/A (foliar) 0.43 oz/1,000 plants (soil)	0.047 lbs ai/A (foliar) 0.125 lbs ai/A (soil)		• Refer to Pollinator Precautionary Section • Refer to resistance management section
Mint	0.063 lbs ai/A (foliar)	0.188 lbs ai/A (foliar)	14 days	• Refer to Pollinator Precautionary Section • Refer to resistance management section

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Clothianidin				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Tree Nuts	0.1 lbs ai/A (foliar)	0.2 lbs ai/A (foliar)	Do not apply treatments less than 10 days apart	• Insecticide must not be applied during bloom or when bees are foraging. • Do not feed or allow livestock to graze on cover crops from treated orchards. • Regardless of the application method, do not apply more than 0.2 lb active ingredient clothianidin per acre per year.
Root and Tuber Vegetables	0.05 lbs ai/A (foliar) 0.2 lbs ai/A (soil)	0.2 lbs ai/A (foliar) 0.2 lbs ai/A (soil)	Do not apply treatments less than 7 days apart	• Do not apply treatment between 50% row closure and petal fall. • Do not make more than one application per year prior to 50% row closure. • Regardless of the application method, do not apply more than 0.2 lb active ingredient clothianidin per acre per year. • Do not apply by air except for potato.
Cereal Grains	0.075 lbs ai/A (foliar; rice)			• Regardless of application method (seed treatment, soil, or foliar), do not apply more than 0.2 lb active ingredient clothianidin per acre per year.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Clothianidin				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Cereal Grains, *continued*	0.023 mg ai/seed (seed treatment; except corn) 1.25 mg ai/seed (seed treatment; corn)			• For use only in commercial seed treatment facilities. Not for use in hopper box, planter box, slurry box, or other on-farm seed treatment applications except for cereal grains and potato seed pieces • Regardless of application method (seed treatment, soil, or foliar), do not apply more than 0.2 lb active ingredient clothianidin per acre per year. • Rice: Do not apply Insecticide after third tillering has initiated. • Rice: Do not apply Insecticide following a clothianidin seed treatment application. • Rice: Do not use Insecticide treated rice fields for the aquaculture of edible fish and crustaceans. • Rice: Insecticide is not to be used on rice crops that contain or support crawfish or any form of aquaculture operation. • Rice: Insecticide is not to be used on rice crops near fish farm, shrimp, prawn or crab pond (or nursery) operations -

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Clothianidin				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Cereal Grains, *continued*				particularly when weather conditions are conducive to drift. Exercise caution with air and ground applications near those operations to avoid product drift.
Legume Vegetables (Succulent or Dried)	0.1 lbs ai/A (foliar) 0.13 mg ai/seed (seed treatment)	0.2 lbs ai/A (foliar)	Do not apply foliar treatments less than 7 days apart	• Do not make foliar applications of clothianidin in fields treated with a neonicotinoid insecticide seed treatment(s) within 45 days after planting. • Regardless of formulation or type of application method, do not apply more than 0.2 lb ai of clothianidin per acre per year. • Do not graze or feed soybean forage and hay to livestock.
Oilseed	0.083 lbs ai/A (foliar) 0.018 mg ai/seed (seed treatment; canola, rapeseed)	0.02 lbs ai/A (foliar)	One year	• Do not make application after pinhead square formation.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Clothianidin				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Cucurbit Vegetables	0.067 lbs ai/A (foliar) 0.2 lbs ai/A (soil)	0.2 lbs ai/A (foliar) 0.2 lbs ai/A (soil)	Do not apply treatments less than 10 days apart	• Insecticide must not be applied during bloom or when bees are foraging. • Do not make application after 4th true leaf on main stem is unfolded
Brassica (Cole) Leafy Vegetables	0.067 lbs ai/A (foliar) 0.2 lbs ai/A (soil)	0.2 lbs ai/A (foliar) 0.2 lbs ai/A (soil)	Do not apply treatments less than 10 days apart	• Insecticide must not be applied during bloom or when bees are foraging. • Do not use on crops grown for seed production
Leafy Vegetables (Except Brassica Vegetables)	0.067 lbs ai/A (foliar) 0.2 lbs ai/A (soil)	0.2 lbs ai/A (foliar) 0.2 lbs ai/A (soil)	10 days	• Do not use on crops grown for seed production. • Insecticide must not be applied during bloom or when bees are foraging.
Tropical and Subtropical Fruit, Inedible Peel	0.1 lb ai/A (foliar; pomegranate)	0.2 lbs ai/A (foliar; pomegranate)	Do not apply treatments less than 14 days apart	• Do not feed or allow livestock to graze on cover crops from treated orchards. • Insecticide must not be applied during bloom or when bees are foraging. • Post bloom applications only

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Clothianidin					
Crop groups listed		**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Berry and Small Fruit	Small fruit vine climbing subgroup except fuzzy kiwifruit	0.1 lbs ai/A (foliar) 0.2 lbs ai/A (soil)	0.2 lbs ai/A (foliar) 0.2 lbs ai/A (soil)	One year for foliar For soil: do not apply treatments less than 14 days apart	
Tropical and Subtropical Fruit, Edible Peel Group		0.1 lbs ai/A (foliar; fig)	0.2 lbs ai/A (foliar; fig)	Do not apply treatments less than 14 days apart.	• Do not feed or allow livestock to graze on cover crops from treated orchards.
Stone Fruit		0.1 lbs ai/A (foliar; peach)	0.2 lbs ai/A (foliar; peach)	Do not apply treatments less than 10 days apart.	• Do not feed or allow livestock to graze on cover crops from treated orchards. • Insecticide must not be applied during bloom or when bees are foraging.
Tobacco		0.067 lbs ai/A (foliar)	0.2 lbs ai/A (foliar)	Do not apply treatments less than 7 days apart.	

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Clothianidin				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Pome Fruit	0.1 lbs ai/A (foliar)	0.2 lbs ai/A (foliar)		• Do not feed or allow livestock to graze on cover crops from treated orchards. • Insecticide must not be applied during bloom or when bees are foraging.

Dinotefuran				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Oilseed	0.134 lbs ai/A (foliar)	0.268 lbs ai/A (foliar)	7 days	• Follow application instructions as indicated in the Bee Hazard Direction for Use.
Cucurbit Vegetable	0.179 lbs ai/A (foliar) 0.33 lbs ai/A (soil)	0.268 lbs ai/A (foliar) 0.536 lbs ai/A (soil)	7 days	• Follow application instructions as indicated in Bee Hazard Direction for Use. • Do not combine foliar applications with soil applications, or vice versa. Only use one application method.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Dinotefuran				
Crop groups listed	**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Fruiting Vegetable	0.179 lbs ai/A (foliar) 0.33 lbs ai/A (soil)	0.268 lbs ai/A (foliar) 0.536 lbs ai/A (soil)	7 days	• Follow application instructions as indicated in Bee Hazard Direction for Use. • Do not combine foliar applications with soil applications, or vice versa. Only use one application method. • Do not apply to vegetables grown for seed.
Root and Tuber Vegetables	0.068 lbs ai/A (foliar) 0.338 lbs ai/A (soil)	0.203 lbs ai/A (foliar) 0.338 lbs ai/A (soil)	14 days	• Follow application instructions as indicated in Bee Hazard Direction for Use. • Do not combine foliar applications with soil applications, or vice versa. Only use one application method.
Brassica Head & Stem Vegetables	0.179 lbs ai/A (foliar) 0.33 lbs ai/A (soil)	0.268 lbs ai/A (foliar) 0.536 lbs ai/A (soil)	7 days	• Do not combine foliar applications with soil applications, or vice versa. Only use one application method. • Do not apply to vegetables grown for seed.

Appendix 3. California Registered Agricultural Uses of Imidacloprid, Thiamethoxam, Clothianidin, and Dinotefuran

Dinotefuran					
Crop groups listed		**Maximum single application rate (soil or foliar)**	**Maximum annual or seasonal application rate (soil or foliar)**	**Minimum reapplication interval**	**Restrictions**
Leafy Vegetables (Except Brassica Vegetables)		0.134 lbs ai/A (foliar) 0.180 lbs ai/A (foliar; watercress) 0.33 lbs ai/A (soil)	0.268 lbs ai/A (foliar) 0.360 lbs ai/A (foliar; watercress) 0.536 lbs ai/A (soil)	7 days	• Do not combine foliar applications with soil applications, or vice versa. Only use one application method. • Do not apply to vegetables grown for seed.
Bulb Vegetables		0.180 lbs ai/A (foliar) 0.270 lbs ai/A (soil)	0.270 lbs ai/A (foliar) 0.270 lbs ai/A (soil)	7 days	• Regardless of application method, do not exceed 0.383 lbs ai/A per crop season.
Berry and Small Fruit	Small fruit vine climbing subgroup except fuzzy kiwifruit	0.135 lbs ai/A (foliar) 0.338 lb ai/A (soil)	0.270 lbs ai/A (foliar) 0.338 lb ai/A (soil)	14 days	• Follow application instructions as indicated in Bee Hazard Direction for Use. • Regardless of application method, do not apply more than a total of 0.540 lbs ai/A per season of Dinoteufran 20 SG.
	Low Growing Berry Subgroup, except strawberry	0.180 lbs ai/A (foliar)	0.360 lbs ai/A (foliar)	14 days	

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the pre-existing crop group; however, the revised crop group number will be followed by a hyphen and the final two digits of the year in which it was established (e.g., if Crop Group 1 is amended in 2007, the revised group will be designated as Crop Group 1-07). If the pre-existing crop group had crop subgroups, these subgroups will be numbered in a similar fashion in the revised crop group. The name of the revised crop group will not be changed from the pre-existing crop group unless the revision so changes the composition of the crop group that the pre-existing name is no longer accurate. Once a revised crop group is established, EPA will no longer establish tolerances under the pre-existing crop group. At appropriate times, EPA will amend tolerances for crop groups that have been superseded by revised crop groups to conform the pre-existing crop group to the revised crop group. Once all of the tolerances for the pre-existing crop group have been updated, the pre-existing crop group will be removed from the CFR.

(k) Establishment of a tolerance does not substitute for the additional need to register the pesticide under a companion law, the Federal Insecticide, Fungicide, and Rodenticide Act. The Registration Division of the Office of Pesticide Programs should be contacted concerning procedures for registration of new uses of a pesticide.

[60 FR 26635, May 17, 1995, as amended at 70 FR 33363, June 8, 2005; 72 FR 69155, Dec. 7, 2007; 75 FR 56014, Sept. 15, 2010; 81 FR 26476, May 3, 2016]

§ 180.41 Crop group tables.

(a) The tables in this section are to be used in conjunction with § 180.40 to establish crop group tolerances.

(b) Commodities not listed are not considered as included in the groups for the purposes of paragraph (b), and individual tolerances must be established. Miscellaneous commodities intentionally not included in any group include globe artichoke, hops, peanut, and water chestnut.

(c) Each group is identified by a group name and consists of a list of representative commodities followed by a list of all commodity members for the group. If the group includes subgroups, each subgroup lists the subgroup name, the representative commodity or commodities, and the member commodities for the subgroup. Subgroups, which are a subset of their associated crop group, are established for some but not all crops groups.

(1) *Crop Group 1:* Root and Tuber Vegetables Group.

(i) *Representative commodities.* Carrot, potato, radish, and sugar beet.

(ii) *Table.* The following table 1 lists all the commodities included in Crop Group 1 and identifies the related crop subgroups.

TABLE 1—CROP GROUP 1: ROOT AND TUBER VEGETABLES

Commodities	Related crop subgroups
Arracacha (*Arracacia xanthorrhiza*)	1C, 1D
Arrowroot (*Maranta arundinacea*)	1C, 1D
Artichoke, Chinese (*Stachys affinis*)	1C, 1D
Artichoke, Jerusalem (*Helianthus tuberosus*)	1C, 1D
Beet, garden (*Beta vulgaris*)	1A, 1B
Beet, sugar (*Beta vulgaris*)	1A
Burdock, edible (*Arctium lappa*)	1A, 1B
Canna, edible (Queensland arrowroot) (*Canna indica*)	1C, 1D
Carrot (*Daucus carota*)	1A, 1B
Cassava, bitter and sweet (*Manihot esculenta*)	1C, 1D
Celeriac (celery root) (*Apium graveolens* var. *rapaceum*)	1A, 1B
Chayote (root) (*Sechium edule*)	1C, 1D
Chervil, turnip-rooted (*Chaerophyllum bulbosum*).	1A, 1B
Chicory (*Cichorium intybus*)	1A, 1B
Chufa (*Cyperus esculentus*)	1C, 1D
Dasheen (taro) (*Colocasia esculenta*)	1C, 1D
Ginger (*Zingiber officinale*)	1C, 1D
Ginseng (*Panax quinquefolius*)	1A, 1B
Horseradish (*Armoracia rusticana*)	1A, 1B
Leren (*Calathea allouia*)	1C, 1D

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TABLE 1—CROP GROUP 1: ROOT AND TUBER VEGETABLES—Continued

Commodities	Related crop subgroups
Parsley, turnip-rooted (*Petroselinum crispum* var. *tuberosum*)	1A, 1B
Parsnip (*Pastinaca sativa*)	1A, 1B
Potato (*Solanum tuberosum*)	1C
Radish (*Raphanus sativus*)	1A, 1B
Radish, oriental (daikon) (*Raphanus sativus* subvar. *longipinnatus*)	1A, 1B
Rutabaga (*Brassica campestris* var. *napobrassica*)	1A, 1B
Salsify (oyster plant) (*Tragopogon porrifolius*).	1A, 1B
Salsify, black (*Scorzonera hispanica*)	1A, 1B
Salsify, Spanish (*Scolymus hispanicus*)	1A, 1B
Skirret (*Sium sisarum*)	1A, 1B
Sweet potato (*Ipomoea batatas*)	1C, 1D
Tanier (cocoyam) (*Xanthosoma sagittifolium*)	1C, 1D
Turmeric (*Curcuma longa*)	1C, 1D
Turnip (*Brassica rapa* var. *rapa*)	1A, 1B
Yam bean (jicama, manoic pea) (*Pachyrhizus* spp.)	1C, 1D
Yam, true (*Dioscorea* spp.)	1C, 1D

(iii) *Table.* The following table 2 identifies the crop subgroups for Crop Group 1, specifies the representative commodity(ies) for each subgroup, and lists all the commodities included in each subgroup.

TABLE 2—CROP GROUP 1 SUBGROUP LISTING

Representative commodities	Commodities
Crop Subgroup 1A. Root vegetables subgroup.	
Carrot, radish, and sugar beet.	Beet, garden; beet, sugar; burdock, edible; carrot; celeriac; chervil, turnip-rooted; chicory; ginseng; horseradish; parsley, turnip-rooted; parsnip; radish; radish, oriental; rutabaga; salsify; salsify, black; salsify, Spanish; skirret; turnip.
Crop Subgroup 1B. Root vegetables (except sugar beet) subgroup.	
Carrot and radish.	Beet, garden; burdock, edible; carrot; celeriac; chervil, turnip-rooted; chicory; ginseng; horseradish; parsley, turnip-rooted; parsnip; radish; radish, oriental; rutabaga; salsify; salsify, black; salsify, Spanish; skirret; turnip.
Crop Subgroup 1C. Tuberous and corm vegetables subgroup.	
Potato.	Arracacha; arrowroot; artichoke, Chinese; artichoke, Jerusalem; canna, edible; cassava, bitter and sweet; chayote (root); chufa; dasheen; ginger; leren; potato; sweet potato; tanier; turmeric; yam bean; yam, true.
Crop Subgroup 1D. Tuberous and corm vegetables (except potato) subgroup.	
Sweet potato.	Arracacha; arrowroot; artichoke, Chinese; artichoke, Jerusalem; canna, edible; cassava, bitter and sweet; chayote (root); chufa; dasheen; ginger; leren; sweet potato; tanier; turmeric; yam bean; yam, true.

(2) *Crop Group 2.* Leaves of Root and Tuber Vegetables (Human Food or Animal Feed) Group (Human Food or Animal Feed) Group.

(i) *Representative commodities.* Turnip and garden beet or sugar beet.

(ii) *Commodities.* The following is a list of all the commodities included in Crop Group 2:

CROP GROUP 2: LEAVES OF ROOT AND TUBER VEGETABLES (HUMAN FOOD OR ANIMAL FEED) GROUP—COMMODITIES

Beet, garden (*Beta vulgaris*)
Beet, sugar (*Beta vulgaris*)
Burdock, edible (*Arctium lappa*)
Carrot (*Daucus carota*)
Cassava, bitter and sweet (*Manihot esculenta*)
Celeriac (celery root) (*Apium graveolens* var. *rapaceum*)
Chervil, turnip-rooted (*Chaerophyllum bulbosum*)
Chicory (*Cichorium intybus*)
Dasheen (taro) (*Colocasia esculenta*)
Parsnip (*Pastinaca sativa*)
Radish (*Raphanus sativus*)
Radish, oriental (daikon) (*Raphanus sativus* subvar. *longipinnatus*)
Rutabaga (*Brassica campestris* var. *napobrassica*)
Salsify, black (*Scorzonera hispanica*)
Sweet potato (*Ipomoea batatas*)
Tanier (cocoyam) (*Xanthosoma sagittifolium*)

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Turnip (*Brassica rapa* var. *rapa*)
Yam, true (*Dioscorea* spp.)

(3) *Crop Group 3.* Bulb Vegetables (*Allium* spp.) Group.

(i) *Representative commodities.* Onion, green; and onion, dry bulb.

(ii) *Commodities.* The following is a list of all the commodities in Crop Group 3.

CROP GROUP 3: BULB VEGETABLE (*Allium* SPP.) GROUP—COMMODITIES

Garlic, bulb (*Allium sativum*)
Garlic, great headed, (elephant) (*Allium ampaloprasum* var. *ampeloprasum*)
Leek (*Allium ampeloprasum, A. porrum, A. tricoccum*)
Onion, dry bulb and green (*Allium cepa, A. fistulosum*)
Onion, Welsh, (*Allium fistulosum*)
Shallot (*Allium cepa* var. *cepa*)

(4) *Crop Group 3-07.* Bulb Vegetable Group.

(i) *Representative Commodities.* Onion, bulb and onion, green.

(ii) *Table.* The following Table 1 lists all the commodities listed in Crop Group 3-07 and identifies the related crop subgroups.

TABLE 1—CROP GROUP 3-07: BULB VEGETABLE GROUP

Commodities	Related crop subgroups
Chive, fresh leaves (*Allium schoenoprasum L.*)	3-07B
Chive, Chinese, fresh leaves (*Allium tuberosum* Rottler ex Spreng)	3-07B
Daylily, bulb (*Hemerocallis fulva* (L.) L. var. *fulva*)	3-07A
Elegans hosta (*Hosta Sieboldiana (Hook.) Engl*)	3-07B
Fritillaria, bulb (*Fritillaria L. fritillary*)	3-07A
Fritillaria, leaves (*Fritillaria L. fritillary*)	3-07B
Garlic, bulb (*Allium sativum* L. var. *sativum*) (*A. sativum* Common Garlic Group)	3-07A
Garlic, great headed, bulb (*Allium ampeloprasum* L. var. *ampeloprasum*) (*A. ampeloprasum* Great Headed Garlic Group)	3-07A
Garlic, Serpent, bulb (*Allium sativum* var. *ophioscorodon* or *A. sativum* Ophioscorodon Group)	3-07A
Kurrat (*Allium kurrat Schweinf. Ex. K. Krause* or *A. ampeloprasum* Kurrat Group)	3-07B
Lady's leek (*Allium cernuum* Roth)	3-07B
Leek *Allium porrum* L. (syn: *A. ampeloprasum L.* var. *porrum* (L.) J. Gay) (*A.ampeloprasum* Leek Group)	3-07B
Leek, wild (*Allium tricoccum* Aiton)	3-07B
Lily, bulb (*Lilium* spp. (*Lilium Leichtlinii* var. *maximowiczii, Lilium lancifolium*))	3-07A
Onion, Beltsville bunching (*Allium* x *proliferum* (Moench) Schrad.) (syn: *Allium fistulosum* L. x *A. cepa* L.)	3-07B
Onion, bulb (*Allium cepa* L. var. *cepa*) (*A. cepa* Common Onion Group)	3-07A
Onion, Chinese, bulb (*Allium chinense* G. Don.) (syn: *A. bakeri* Regel)	3-07A
Onion, fresh (*Allium fistulosum* L. var. *caespitosum* Makino)	3-07B
Onion, green (*Allium cepa* L. var. *cepa*) (*A. cepa* Common Onion Group)	3-07B
Onion, macrostem (*Allium macrostemom* Bunge)	3-07B
Onion, pearl (*Allium porrum* var. *sectivum* or *A. ampeloprasum* Pearl Onion Group)	3-07A
Onion, potato, bulb (*Allium cepa* L. var. *aggregatum* G. Don.) (*A. cepa* Aggregatum Group)	3-07A
Onion, tree, tops (*Allium x proliferum* (Moench) Schrad. ex Willd.) (syn: *A. cepa* var. *proliferum* (Moench) Regel; *A. cepa* L. var. *bulbiferum* L.H. Bailey; *A. cepa* L. var. *viviparum* (Metz.) Alef.)	3-07B
Onion, Welsh, tops (*Allium fistulosum* L.)	3-07B
Shallot, bulb (*Allium cepa* var. *aggregatum* G. Don.)	3-07A
Shallot, fresh leaves (*Allium cepa* var. *aggregatum* G. Don.)	3-07B
Cultivars, varieties, and/or hybrids of these.	

(iii) *Table.* The following Table 2 identifies the crop subgroups for Crop Group 3-07, specifies the representative commodities for each subgroup and lists all the commodities included in each subgroup.

TABLE 2—CROP GROUP 3-07: SUBGROUP LISTING

Representative commodities	Commodities
Crop subgroup 3-07A. Onion, bulb, subgroup. Onion, bulb.	Daylily, bulb; fritillaria, bulb; garlic, bulb; garlic, great-headed, bulb; garlic, serpent, bulb; lily, bulb; onion, bulb; onion, Chinese, bulb; onion, pearl; onion, potato, bulb; shallot, bulb; cultivars, varieties, and/or hybrids of these.
Crop subgroup 3-07B. Onion, green, subgroup. Onion, green.	Chive, fresh leaves; chive, Chinese, fresh leaves; elegans hosta; fritillaria, leaves; kurrat; lady's leek; leek; leek, wild; Onion, Beltsville bunching; onion, fresh; onion, green; onion, macrostem; onion, tree, tops; onion, Welsh, tops; shallot, fresh leaves; cultivars, varieties, and/or hybrids of these.

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(5) *Crop Group 4.* Leafy Vegetables (Except *Brassica* Vegetables) Group.

(i) *Representative commodities.* Celery, head lettuce, leaf lettuce, and spinach (*Spinacia oleracea*).

(ii) *Table.* The following table 1 lists all the commodities included in Crop Group 4 and identifies the related crop subgroups.

TABLE 1—CROP GROUP 4: LEAFY VEGETABLES (EXCEPT BRASSICA VEGETABLES) GROUP

Commodities	Related crop subgroups
Amaranth (leafy amaranth, Chinese spinach, tampala) (*Amaranthus* spp.)	4A
Arugula (Roquette) (*Eruca sativa*)	4A
Cardoon (*Cynara cardunculus*)	4B
Celery (*Apium graveolens* var. *dulce*)	4B
Celery, Chinese (*Apium graveolens* var. *secalinum*)	4B
Celtuce (*Lactuca sativa* var. *angustana*)	4B
Chervil (*Anthriscus cerefolium*)	4A
Chrysanthemum, edible-leaved (*Chrysanthemum coronarium* var. *coronarium*)	4A
Chrysanthemum, garland (*Chrysanthemum coronarium* var. *spatiosum*)	4A
Corn salad (*Valerianella locusta*)	4A
Cress, garden (*Lepidium sativum*)	4A
Cress, upland (yellow rocket, winter cress) (*Barbarea vulgaris*)	4A
Dandelion (*Taraxacum officinale*)	4A
Dock (sorrel) (*Rumex* spp.)	4A
Endive (escarole) (*Cichorium endivia*)	4A
Fennel, Florence (finochio) (*Foeniculum vulgare* Azoricum Group)	4B
Lettuce, head and leaf (*Lactuca sativa*)	4A
Orach (*Atriplex hortensis*)	4A
Parsley (*Petroselinum crispum*)	4A
Purslane, garden (*Portulaca oleracea*)	4A
Purslane, winter (*Montia perfoliata*)	4A
Radicchio (red chicory) (*Cichorium intybus*)	4A
Rhubarb (*Rheum rhabarbarum*)	4B
Spinach (*Spinacia oleracea*)	4A
Spinach, New Zealand (*Tetragonia tetragonioides, T. expensa*)	4A
Spinach, vine (Malabar spinach, Indian spinach) (*Basella alba*)	4A
Swiss chard (*Beta vulgaris* var. *cicla*)	4B

(iii) *Table.* The following table 2 identifies the crop subgroups for Crop Group 4, specifies the representative commodities for each subgroup, and lists all the commodities included in each subgroup.

TABLE 2—CROP GROUP 4 SUBGROUP LISTING

Representative commodities	Commodities
Crop Subgroup 4A. Leafy greens subgroup. Head lettuce and leaf lettuce, and spinach (*Spinacia oleracea*).	Amaranth; arugula; chervil; chrysanthemum, edible-leaved; chrysanthemum, garland; corn salad; cress, garden; cress, upland; dandelion; dock; endive; lettuce; orach; parsley; purslane, garden; purslane, winter; radicchio (red chicory); spinach; spinach, New Zealand; spinach, vine.
Crop Subgroup 4B. Leaf petioles subgroup. Celery.	Cardoon; celery; celery, Chinese; celtuce; fennel, Florence; rhubarb; Swiss chard.

(6) *Crop Group 4–16.* Leafy Vegetable Group.

(i) *Representative commodities.* Head lettuce, leaf lettuce, mustard greens, and spinach.

(ii) *Commodities.* The following Table 1 lists all commodities included in Crop Group 4–16.

TABLE 1—CROP GROUP 4–16: LEAFY VEGETABLE GROUP

Commodities	Related crop subgroups
Amaranth, Chinese (*Amaranthus tricolor* L.)	4–16A

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TABLE 1—CROP GROUP 4–16: LEAFY VEGETABLE GROUP—Continued

Commodities	Related crop subgroups
Amaranth, leafy (*Amaranthus* spp.)	4–16A
Arugula (*Eruca sativa* Mill.)	4–16B
Aster, Indian (*Kalimeris indica* (L.) Sch. Bip.)	4–16A
Blackjack (*Bidens pilosa* L.)	4–16A
Broccoli, Chinese (*Brassica oleracea* var. *alboglabra* (L.H. Bailey) Musil)	4–16B
Broccoli raab (*Brassica ruvo* L.H. Bailey)	4–16B
Cabbage, abyssinian (*Brassica carinata* A. Braun)	4–16B
Cabbage, Chinese, bok choy (*Brassica rapa* subsp. *chinensis* (L.) Hanelt)	4–16B
Cabbage, seakale (*Brassica oleracea* L. var. *costata* DC.)	4–16B
Cat's whiskers (*Cleome gynandra* L.)	4–16A
Cham-chwi (*Doellingeria scabra* (Thunb.) Nees)	4–16A
Cham-na-mul (*Pimpinella calycina* Maxim)	4–16A
Chervil, fresh leaves (*Anthriscus cerefolium* (L.) Hoffm.)	4–16A
Chipilin (*Crotalaria longirostrata* Hook & Arn)	4–16A
Chrysanthemum, garland (*Glebionis coronaria* (L.) Cass. ex Spach. *Glebionis* spp.)	4–16A
Cilantro, fresh leaves (*Coriandrum sativum* L.)	4–16A
Collards (*Brassica oleracea L.* var. *viridis* L.)	4–16B
Corn salad (*Valerianella* spp.)	4–16A
Cosmos (*Cosmos caudatus* Kunth)	4–16A
Cress, garden (*Lepidium sativum* L.)	4–16B
Cress, upland (*Barbarea vulgaris* W.T. Aiton)	4–16B
Dandelion, leaves (*Taraxacum officinale* F.H. Wigg. Aggr.)	4–16A
Dang-gwi, leaves (*Angelica gigas Nakai*)	4–16A
Dillweed (*Anethum graveolens* L.)	4–16A
Dock (*Rumex patientia* L.)	4–16A
Dol-nam-mul (*Sedum sarmentosum* Bunge)	4–16A
Ebolo (*Crassocephalum crepidioides* (Benth.) S. Moore)	4–16A
Endive (*Cichorium endivia* L.)	4–16A
Escarole (*Cichorium endivia* L.)	4–16A
Fameflower (*Talinum fruticosum* (L.) Juss.)	4–16A
Feather cockscomb (*Glinus oppositifolius* (L.) Aug. DC.)	4–16A
Good King Henry (*Chenopodium bonus-henricus* L.)	4–16A
Hanover salad (*Brassica napus* var. *pabularia* (DC.) Rchb.)	4–16B
Huauzontle (*Chenopodium berlandieri* Moq.)	4–16A
Jute, leaves (*Corchorus spp.*)	4–16A
Kale (*Brassica oleracea* L. var. *Sabellica* L.)	4–16B
Lettuce, bitter (*Launaea cornuta* (Hochst. ex Oliv. & Hiern) C. Jeffrey)	4–16A
Lettuce, head (*Lactuca sativa* L.; including *Lactuca sativa* var. *capitata* L.)	4–16A
Lettuce, leaf (*Lactuca sativa* L.; including *Lactuca sativa* var. *longifolia* Lam.; *Lactuca sativa* var. *crispa* L.)	4–16A
Maca, leaves (*Lepidium meyenii* Walp.)	4–16B
Mizuna (*Brassica rapa* L. subsp. *nipposinica* (L.H. Bailey) Hanelt)	4–16B
Mustard greens (*Brassica juncea* subsp., including *Brassica juncea* (L.) Czern. subsp. *integrifolia* (H. West) Thell., *Brassica juncea* (L.) Czern. var. *tsatsai* (T.L. Mao) Gladis)	4–16B
Orach (*Atriplex hortensis* L.)	4–16A
Parsley, fresh leaves (*Petroselinum crispum* (Mill.) Fuss; *Petroselinum crispum* var. *neapolitanum* Danert)	4–16A
Plantain, buckthorn (*Plantago lanceolata* L.)	4–16A
Primrose, English (*Primula vulgaris* Huds.)	4–16A
Purslane, garden (*Portulaca oleracea* L.)	4–16A
Purslane, winter (*Claytonia perfoliata* Donn ex Willd.)	4–16A
Radicchio (*Cichorium intybus* L.)	4–16A
Radish, leaves (*Raphanus sativus* L. var *sativus,* including *Raphanus sativus* L. var. *mougri* H. W. J. Helm (*Raphanus sativus* L. var. *oleiformis* Pers)	4–16B
Rape greens (*Brassica napus* L. var. *napus,* including *Brassica rapa* subsp. *trilocularis* (Roxb.) Hanelt; *Brassica rapa* subsp. *dichotoma* (Roxb.) Hanelt; *Brassica rapa* subsp. *oleifera* Met)	4–16B
Rocket, wild (*Diplotaxis tenuifolia* (L.) DC.)	4–16B
Shepherd's purse (*Capsella bursa-pastoris* (L.) Medik)	4–16B
Spinach (*Spinacia oleracea* L.)	4–16A
Spinach, Malabar (*Basella alba* L.)	4–16A
Spinach, New Zealand (*Tetragonia tetragonioides* (Pall.) Kuntze)	4–16A
Spinach, tanier (*Xanthosoma brasiliense* (Desf.) Engl.)	4–16A
Swiss chard (*Beta vulgaris* L. ssp. *vulgaris*)	4–16A
Turnip greens (*Brassica rapa* L. ssp. *rapa*)	4–16B
Violet, Chinese, leaves (*Asystasia gangetica* (L.) T. Anderson)	4–16A
Watercress (*Nasturtium officinale* W.T. Aiton)	4–16B
Cultivars, varieties, and hybrids of these commodities.	

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(iii) *Crop subgroups.* The following Table 2 identifies the crop subgroups for Crop Group 4–16, specifies the representative commodities for each subgroup, and lists all the commodities included in each subgroup.

TABLE 2—CROP GROUP 4–16: SUBGROUP LISTING

Representative commodities	Commodities
Crop Subgroup 4–16A. Leafy greens subgroup	
Head lettuce, leaf lettuce, and spinach	Amaranth, Chinese; amaranth, leafy; aster, Indian; blackjack; cat's whiskers; cham-chwi; cham-na-mul; chervil, fresh leaves; chipilin; chrysanthemum, garland; cilantro, fresh leaves; corn salad; cosmos; dandelion, leaves; dang-gwi, leaves; dillweed; dock; dol-nam-mul; ebolo; endive; escarole; fameflower; feather cockscomb; Good King Henry; huauzontle; jute, leaves; lettuce, bitter; lettuce, head; lettuce, leaf; orach; parsley, fresh leaves; plantain, buckhorn; primrose, English; purslane, garden; purslane, winter; radicchio; spinach; spinach, Malabar; spinach, New Zealand; spinach, tanier; Swiss chard; violet, Chinese, leaves; cultivars, varieties, and hybrids of these commodities.
Crop Subgroup 4–16B. *Brassica* leafy greens subgroup	
Mustard greens	Arugula; broccoli, Chinese; broccoli raab; cabbage, abyssinian; cabbage, Chinese, bok choy; cabbage, seakale; collards; cress, garden; cress, upland; hanover salad; kale; maca, leaves; mizuna; mustard greens; radish, leaves; rape greens; rocket, wild; shepherd's purse; turnip greens; watercress; cultivars, varieties, and hybrids of these commodities.

(7) *Crop Group 5. Brassica* (Cole) Leafy Vegetables Group.

(i) *Representative commodities.* Broccoli or cauliflower; cabbage; and mustard greens.

(ii) *Table.* The following table 1 lists all the commodities included in Crop Group 5 and identifies the related crop subgroups.

TABLE 1—CROP GROUP 5: *Brassica* (COLE) LEAFY VEGETABLES

Commodities	Related crop subgroups
Broccoli (*Brassica oleracea* var. *botrytis*)	5A
Broccoli, Chinese (gai lon) (*Brassica alboglabra*)	5A
Broccoli raab (rapini) (*Brassica campestris*)	5B
Brussels sprouts (*Brassica oleracea* var. *gemmifera*)	5A
Cabbage (*Brassica oleracea*)	5A
Cabbage, Chinese (bok choy) (*Brassica chinensis*)	5B
Cabbage, Chinese (napa) (*Brassica pekinensis*)	5A
Cabbage, Chinese mustard (gai choy) (*Brassica campestris*)	5A
Cauliflower (*Brassica oleracea* var. *botrytis*)	5A
Cavalo broccolo (*Brassica oleracea* var. *botrytis*)	5A
Collards (*Brassica oleracea* var. *acephala*)	5B
Kale (*Brassica oleracea* var. *acephala*)	5B
Kohlrabi (*Brassica oleracea* var. *gongylodes*)	5A
Mizuna (*Brassica rapa* Japonica Group)	5B
Mustard greens (*Brassica juncea*)	5B
Mustard spinach (*Brassica rapa* Perviridis Group)	5B
Rape greens (*Brassica napus*)	5B

(iii) *Table.* The following table 2 identifies the crop subgroups for Crop Group 5, specifies the representative commodity(ies) for each subgroup, and lists all the commodities included in each subgroup.